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ABSTRACT

This study investigates interaction patterns that occur in an open plan and in a traditional plan school. The objectives of the study were: (1) to investigate some interaction patterns among members of the school populations, (2) to investigate some interaction patterns between the school population and the available physical resources, (3) to investigate the physical systems as a background to the educational environment, and (4) to organize information to be used in developing design criteria for educational facilities. Two public elementary schools, matched for educational philosophy, available resources, budget, and demographic description, were selected for the study. Data were taken from discrete time sample viewing of remote-controlled videotape recordings made simultaneously in the schools, controlling for subject, time of day, and day of week. Videotape information was supplemented by informal interviews, observations, and measures of the physical environmental systems. The results suggest three general conclusions: (1) the open plan design appears to facilitate the interaction patterns of the schools' philosophy better than the fixed plan, (2) there is more use of the available physical resources in the open plan school, and (3) first grade and fourth grade interaction patterns may necessitate different design requirements. Photographs may reproduce poorly. (Author/MLF)

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a comparison of interaction patterns in an open space and a fixed plan school

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abstract

Comparative evaluation of educational programs connotes testing the performance of students, most often by standard achievement tests. Comparative evaluation of educational facilities usually tests the performance of the physical environment - light, sound, temperature. The dynamic interaction of the performance of the human and physical resources is rarely analyzed. Evaluation of this interaction in existing educational systems may provide behavioral and technical information for design criteria for schools.

An interdisciplinary research team of students from Virginia Polytechnic Institute and State University designed an ethological study to investigate some different interaction patterns which occur in an open plan and a traditional, fixed plan school. The objectives of the study were: (1) to investigate some interaction patterns among members of the school populations; (2) to investigate some interaction patterns between the school population and the available physical resources; (3) to investigate the physical systems as background to the educational environment; (4) to organize information to be used in developing design criteria for educational facilities.

Two public elementary schools, matched for educational philosophy, available resources, budget, and demographic description, were selected for the study. One school had a traditional design of self-contained classroom. The second was an open plan design. With the cooperation of the participating principals and teachers, remote-controlled videotape recorders were concealed from the students, and used to observe first and fourth grade classes for four weeks. Recordings were made simultaneously in the schools, controlling for subject, time of day, and day of week. Data were taken from discrete time sample viewing of the tapes and recorded on standardized observation sheets. Videotape information was supplemented by informal interviews, observations, and measures of the physical environmental systems.

The results suggest three general conclusions: (1) the open plan design appears to facilitate the interaction patterns of the schools' philosophy better than the fixed plan; (2) there is more use of the available physical resources in the open plan school; and (3) first grade and fourth grade interaction patterns may necessitate different design requirements.

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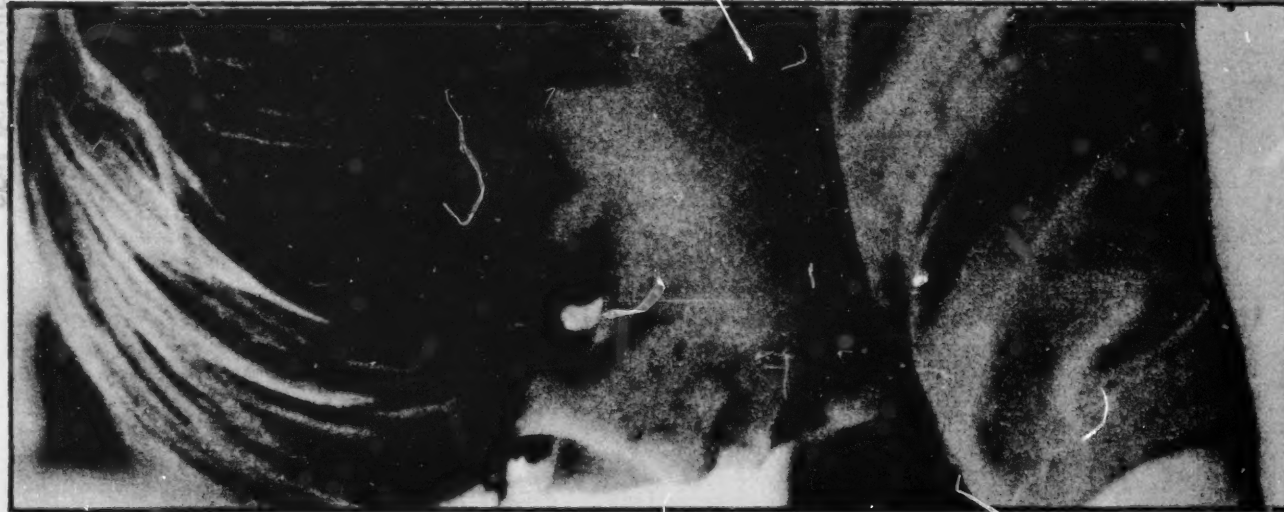
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Interaction Patterns
in an Open Space
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Virginia Polytechnic Institute
and State University,
Blacksburg, Virginia,
Colleges of Architecture,
General Arts and Sciences,
and Education

in cooperation with
the Montgomery County
School System, Virginia

participants
student project director
Paula Clem

Katherine Ahern
Nancy Dailey
Miriam Gay
Marcia Scantlebury

correspondence may be sent to
Paula Clem
2165-C Mulberry Street
Salem, Virginia

[1973]

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Introduction

The evaluation of an educational system has generally relied on the results of standardized achievement tests. How effective, though, are these measures? How deeply does this type of evaluation go into the nature of the school, and into the philosophy by which everyday procedures are shaped? How does this measure the total learning experience of the student? The educational environment is an integration of philosophy, facility, students, and staff, and thus the school becomes a system of human and physical resources. The patterns of interactions among these various elements are the nature of the school. It is these patterns of user behavior that need to be described if an honest evaluation is to be made. Test scores are one of the results of the system, but they are only one element of a total end product.

The question then raised is how these patterns of user behavior can best be analyzed. Evaluation of school facilities has been carried out on many scales ranging from informal internal surveys to highly organized and funded research. Shawsville Elementary School in Montgomery County, Virginia, compiled the responses to a questionnaire sent to parents regarding their satisfaction with the new open plan school

The results showed a generally favorable reaction. Both SEF and SCSD have carried out extensive evaluation of their educational facilities projects. The performance specifications used in each program ensured the quality and defined the evaluation criteria of the physical systems. Interviews, questionnaires and direct observations provided information on the user's satisfaction. Jerome Durlak's "Interim Report" on the evaluation of 16 different SEF and non-SEF schools in Toronto is the most comprehensive evaluation of school facilities to date.

Questionnaires, subjective analysis, reports, direct observations and interviews are methods which can be used, but evaluator and the known process of evaluation will have an effect on the responses. For this reason, a method of evaluation of the "normal" activities of the educational environment is needed. This study is a direct response to this need.

A team of students at VPI & SU from the colleges of education, architecture, and psychology, have developed methods by which patterns of user behavior can be described. These methods have been directed towards four major objectives: (1) to investigate interaction

patterns among members of the school population, 2) to investigate interactions between the school population and the available, physical resources, 3) to investigate the physical systems as the background of the educational environment and 4) to make available information that can be used in developing design criteria for educational environments.

The group chose to study both an open and a fixed plan elementary school in order to compare and contrast the use of two schools which have different architectural designs. A methodology had to be developed which would enable the group to study activities in the school without having an effect on the procedures or behaviors in the areas to be studied.

Zoologists had developed ethological research methods which were designed to collect information on existing natural behaviors of animals in their natural habitat. The kinds of information produced by these methods proved useful in developing unobtrusive methods for evaluating schools. Both the patterns of interaction among people in the school and the interactions between the people and the available physical resources are natural behaviors occurring in a natural human habitat.

Ethological studies of pre-school children have been carried out using direct and unobtrusive observation techniques. This research has been related to the wealth of information regarding the intellectual, physical, psychological and sociological development of the child. The work of McGrew, Jones, and Connelly has used direct observation to record the behaviors of children in a nursery environment. Steps toward the development of a human ethogram have been taken, as evidenced by the work of Grant and McGrew. The ethological studies of these researchers emphasize the identification of behavior patterns which are repeated. These patterns are the basis of operational definitions of types of interactional and individual behavior.

To date, unobtrusive observation techniques in elementary and secondary schools has been limited to the supplementary use of film and video tape in the work of Johnson & Chapman. Ethological studies relying solely on unobtrusive observation of the behavior patterns of interaction remain undocumented.

The study of interaction patterns would be incomplete if the physical background of

the environment were not taken into consideration. Qualities of light, sound and air can affect people and their use of a space in the same manner as materials, furniture, color and texture. To understand the use of a space, it becomes important to analyze as much of the microenvironment as possible. Any special quality could influence the user patterns, especially if it varies from neighboring locations.

In the EFL Study, Contrast Rendition, the lighting systems of eighteen schools were measured and evaluated, determining problems with existing systems.

Acoustical Environment of School Buildings, another EFL study, measured five variables of acoustics and gathered by questionnaire the user's opinion of the acoustics and an overall rating of the school. In the report Noise, Distraction and Privacy in Conventional and Open Plan Schools Environments, Frank A. Brunetti measured noise level, temperature, and humidity, observed student behavior and collected student evaluative questionnaires. Noise factors were concentrated on to determine their influence on distractibility. Jerome Durlak's "Interim

Report" on Toronto schools included a comprehensive questionnaire dealing with comfort and an overall evaluation of the school facilities. However, the total physical environment has not been measured and dealt with as a background, influencing normal classroom behavior.

Once the study of background and activity is established, the information will be available for evaluation and for use in developing design criteria. Schools seem to be most successful in terms of user satisfaction when the designers have been instructed by representatives of all parts of the educational community on the present and future educational programs of the school.

One difficulty in programming or evaluating an educational facility is the lack of operationally defined educational goals and objectives. The school community must provide the designer with behavioral as well as spatial and technical requirements. When a designer is educated in these requirements, and the users are educated in the potential of the schoolhouse as a system of resources, then an educational community can be used in a dynamic interrelation of human and physical resources.

This study has developed and implemented research methods which are capable of generating the information necessary to the objectives of the study. We hope to begin to organize the known user requirements for and consequences of different types of educational facilities. From this evaluation and analysis of existing schoolhouses, a data bank of technical, spatial and user information could be developed into easily retrievable, usable design information for both the educator and the architect.



methodology

Matching as a selection procedure is meaningful only to the extent that relevant confounding variables are identified and controlled." The research group visited and interviewed various school systems in Virginia and West Virginia to find two schools with the necessary matched background criteria. Shawsville Elementary, an open plan school, and Belview Elementary, a fixed plan school, were chosen for the study. Both schools chosen were under the auspices of the same school system in Montgomery County, Virginia, in order to assure educational consistency.

Principals, vice-principals, school board personnel and head teachers were interviewed in order to acquire information concerning the two schools' populations, resources, teaching methods, and philosophies. The populations were matched on the basis of:

- (1) number of children in the school
- (2) number of children per class
- (3) annual income of the families, (based on number of children in the free lunch program)
- (4) number of teachers
- (5) number of student teachers
- (6) number of assistants and parent helpers
- (7) racial ratio

Emphasis was placed not only

on matched populations, but on matched resources as well. The resources were equated on the basis of:

- (1) number and type of audiovisual equipment
- (2) number and type of textbooks
- (3) number and type of physical education equipment
- (4) number and type of games
- (5) number and type of educational equipment (globes, maps, etc.)
- (6) number and type of fixed markings and readings (see appendix)
- (7) number and type of portable markings and readings.

Consideration was also given to teaching methods. Both schools utilized learning centers, had homogeneous groupings for math and language arts, and heterogeneous groupings for science (scis) and social studies.

Neither school employed the use of multi-age groupings. The county-wide educational philosophy emphasized child-oriented, individualized, resource assisted learning, and discovery by doing.

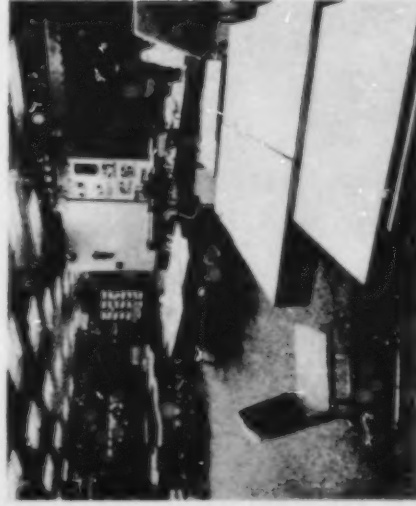
Two grade levels with 2 classes from each level were chosen for the study. The first grade was chosen so that one of the two groups would consist of students with no previous exposure to any type of school building other than the one in which they were then enrolled,

be that open or fixed. The use of kindergarten was eliminated due to the fact that Montgomery County does not have a county-wide program in kindergarten instruction.

An upper grade level was chosen in order to collect data on two groups of students, one which had been in a fixed plan school and was then transferred to an open plan school, and a similarly aged group of students who had spent all of their school years in a fixed plan school. Fourth graders were chosen as subjects rather than fifth graders, whose behaviour may have been affected by their pending entrance into intermediate school.

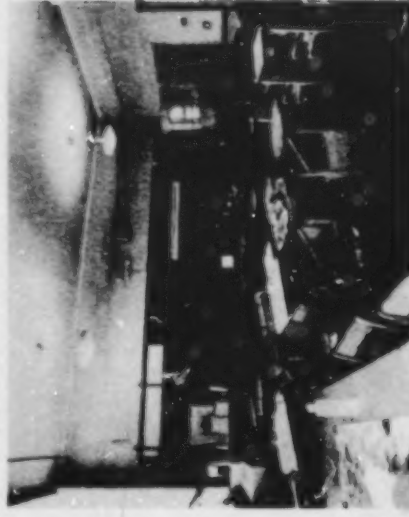
Members of the research team took an inventory, prior to filming, of all four classrooms being observed, in order to assure that the classrooms of equivalent grade level contained basically the same type and quantity of learning resources, equipment, and furniture.

In the two first grade classrooms, 395 items were recorded. Of these, 377 items were found to exist in the same type and amount in both classrooms. Of the 8 remaining items, Shawsville had 1 fire extinguisher, 2 filing cabinets and 5 plastic scales, whereas Belview had none of these items. A differ-



ence also existed in the area of architectural elements/conditions and environmental systems. Shawsville had recessed lighting, wall to wall carpeting, central heating and air conditioning, and no doors entering into the classroom area. Belview had suspended fluorescent lighting, windows and radiators, one scatter rug on a tile floor, and a door.

In the fourth grade classrooms, 245 items were recorded. Of these, 239 items were found to exist in the same type and amount. Of the six items remaining, Shawsville had no wet area within the classroom area to be filmed, and had 4 portable book shelves and 4 wall maps. Belview had 1 wet area, 1 portable book shelf and only 2 wall maps. The same differences in architectural elements/conditions and environment-



al systems that were noted in the first grades exist in the fourth grades. (a detailed list of all resources found in each separate classroom is available upon request.)

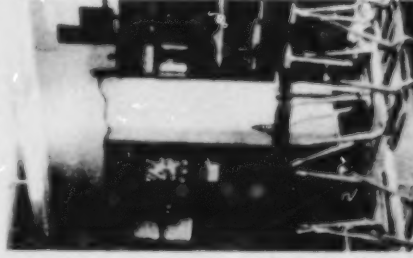
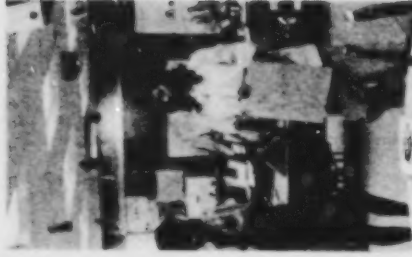
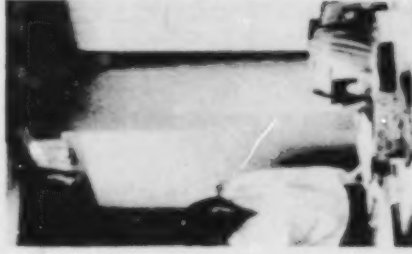
The video-taping schedule consisted of 15 minute taping times scheduled over a period of not more than 10 school days per grade. The selection of specific areas to be taped was then determined by the individual classroom activities. A comparison of the regular teaching schedules showed them to be almost identical between the two first grades and the two four grades. The educational subjects to be taped were chosen from the scheduled courses taught daily in both schools. Because of the nearly identical class schedules the group was able to:

- 1) control for confounding variables such as weather, and the marked differences between 8:30 a.m. and 2:30 p.m., or between Monday and Friday, and
- 2) obtain a hypothetical day, encompassing the initiation, duration and termination of the activities of the chosen subjects - math, language arts, science and social studies.

The general location at which each subject was usually held was determined and the videotape camera location was then selected by matching subjects

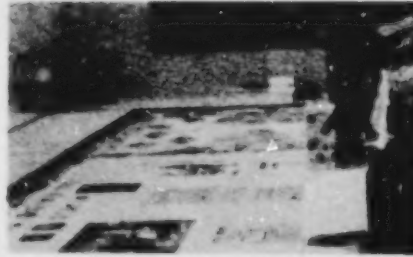
to be filmed with the areas in which they took place. A wide angle lens was used in order to obtain the largest possible number of instructional areas.

A box, designed to house the camera and hide it from the subjects view, was positioned on a 12" x 15" shelf attached to a wall approximately 10' above the floor. The positioning of the box at that height allowed for optimum area cover-



age and prevented the subjects from tampering with the equipment.

Following a one week period of habituation to the box, the camera was fastened into it with a tri-pod attachment that enabled it to be maneuvered into the most desirable position. 70 foot cables from the camera to the tape deck were fabricated so that the taping unit could be remotely located



where neither the observer nor the equipment could be seen or heard by the class being filmed. The Sony Porta-Pack videotape unit was chosen because it was small, easily hidden, quiet during operation, and readily available.

Each of the four instructional areas to be filmed was divided into "locations" on the basis of existing furniture and architectural elements. These loca-

tions were mapped and numbered for easy reference. (see environmental section for maps.)

The daily taping and measuring procedure began at 6:30 am. One team member went to each school, arriving approximately 45 minutes before the students. (The first grade classes were taped during the first 10 days of data collection, followed by the taping of the fourth grade classes.) Environmental



data was taken by location in the areas taped.

Natural and mechanical systems data was collected to provide background information for each of the selected locations. The collection of systems data was broken down into two categories: the experiential data and the measurable data. Experiential data consisted of any noticeable changes in the environment evident on the vi-

deotapes or noticed by the observer before or after school, or during the daily breaks.

In order to maintain unobtrusive data taking techniques, the measurable data could only be taken when the subjects were absent from the room, and after the videotaping was completed. Therefore the measurable data was broken down into two categories: those that depended upon the weather and/or described the cycle of the day, and those that were more dependant upon construction of and materials used in the building itself.

The cyclic data was taken before school, during the daily p.e. break, and after school, and included the combined illumination levels of sunlight and light fixtures, the air temperature, and the relative humidity. The light readings were taken in footcandles:

a General Electric type 213 meter was used in Shawsville, and a Gossen Super Pilotcds meter was used in Belview.

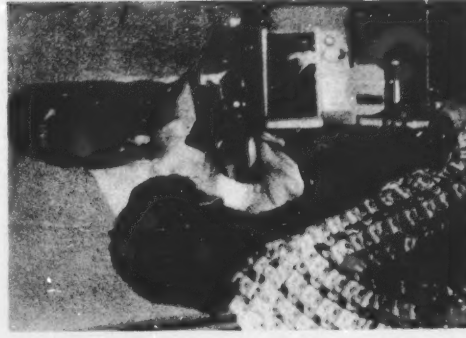
Wet bulb and dry bulb temperatures were initially taken by two Wexler psychrometers no. 317 and later by two larger Princo psychrometers.

Relative humidity was calculated by a psychrometric slide-rule. These measures were recorded on daily data sheets, and averages were determined for each of the above

three time periods in each location. The low and high in each location was also noted.

The second data category included light reflectance reading taken by a general electric 126 dual range light meter. Air motion was measured by an alnor thermo-anemometer. Although dependant upon the infiltrating outside breezes, the air motion was not handled as cyclic data, and only the actual air handling system's velocity was measured. The background sound levels were measured with a band k type 2205 sound level meter to determine which sounds influenced the spaces.

The video-tape was set up and checked. The daily taping schedule was followed. (see appendix.) The equipment was then cleaned and put away.



Following a full day of taping in the schools, the entire group met together to analyze the taped data. The film was played on a Sony 3600 and viewed on a large television monitor which afforded maximum picture quality and ease of viewing.

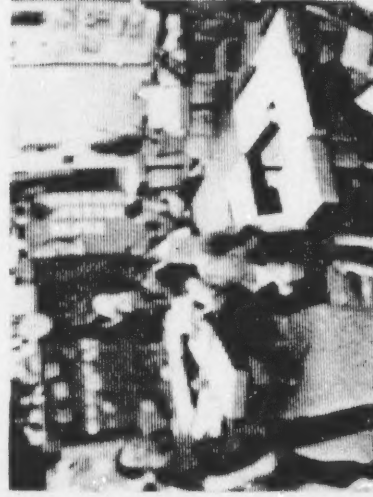
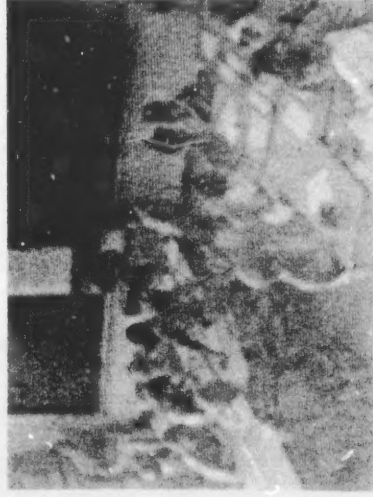
The procedure for analyzing taped data was that of discrete time sampling. The video-tape was stopped at 2 1/2 minute

intervals. At the stopped frame,

- 1) a 35 mm black and white photograph was taken of the frame;
- 2) each group member noted the stopped action of all the subjects within specific locations assigned and
- 3) the data was systematically recorded on optical scanning sheets for each individual interaction, noting the location, classifications, initiator, terminator, duration, and phy-

sical resources used. (See appendix for code sheet and scan sheet).

Group or individual behavior was determined by our definition of an interaction. (See appendix). Unanimous agreement was reached for each interaction to insure accuracy and control of tape analysis. The tape was moved backwards and forwards from the stopped frame: 1) time interactions





between two or more subjects;
2) to obtain information on the
initiators and terminators; and
3) to clarify ambiguous activi-
ties.

Following the documentation of
data on optical scanning
sheets, the information was
transferred to computer cards.
Due to the nominal nature of
our data, and to the large
number of observations, the
statistical package for social

sciences histograms and
fastabs programs were chosen
for use. The fastabs program
enabled every variable to be
cross-tabulated with every
other variable. This proce-
dure was then repeated, con-
trolling for school and grade.

(For a complete listing of
equipment used, see appendix).

results

The observations recorded from the stopped frames were evenly distributed between both schools and grades. Of all the observations, 51.1% were from Belview Elementary School, and 48.8% were from Shawsville Elementary School. Of all the observations, 49.6% were from the first grades, and 50.2% were from the fourth grades. There were 3,412 observations; 521 of these were recorded as interactions involving two or more persons, and 2,882 of these observations were noted as depicting individual behavior.

While not all of the statistics to be presented were incorporated into the discussion of our study, we feel that the remaining statistics are worth reporting because of their value to educators and architects involved in the design of educational environments. The reader should bear in mind that in some instances, the statistics shown do not approach 100%. This is a result of some interactions recorded either having begun before, or ended after, the scheduled 15 minute taping periods. Occurrences of this nature were recorded as being "undetermined by tape."

The following findings are of a general nature, with no controls for either school or grade.

Student/teacher groups included five or more persons 70.0% of the time. Groups of two, three, or four persons were initiated by students 89.7% of the time, while teachers initiated 71.7% of all groups involving five or more persons.

Teachers initiated the majority (63.3%) of all homogeneous activities, while students initiated almost half, (47.8%) of all heterogeneous activities. Of all student-initiated interactions, 46.0% were involved with heterogeneous activities, and 48.9% involved homogeneous activities.

There was more often 90% involvement on the part of the students in an identical teacher-initiated task when the activity was of a heterogeneous nature than if it was of a homogeneous one. Only 13.1% of all homogeneous activities incurred 90% involvement, whereas 29.0% of all heterogeneous activities did so.

Heterogeneous classes used material cyclical more often than did homogeneous classes. Materials cyclical were used 17.4% of the time here; heterogeneous activities were in session, compared with only 4.9% of the time homogeneous activities were in session.

Eighty-eight percent of all teacher initiated interactions

were homogeneous activities. Students, however, terminated homogeneous activities twice as frequently as did teachers. Students terminated 53.1% of all interactions involving homogeneous activities, whereas teachers terminated only 24.8% of such activities. Heterogeneous interactions were also more often student terminated than teacher terminated. Of all interactions involving heterogeneous activities, 66.2% were student terminated and 19.9% were teacher terminated.

Student/student interactions were relatively short. Student/student interactions less than three minutes in duration accounted for 81.4% of all interactions lasting less than three minutes. Student/student interactions of less than 30 seconds accounted for 55.2% of all interactions lasting less than 30 seconds.

As the durations of the interactions increased, student/teacher interactions occurred more frequently. (see figure 1)

Interactions lasting longer than 300 seconds were student/teacher groups twice as often as they were student/student groups. Of these very long interactions, (301 seconds and longer), 59.9% involved student/teacher groups, and 23.3% involved student/student groups.

Interactions involving student/student groups were three times more likely to be very short (lasting between 0-10 seconds) than were student/teacher interactions. Of the interactions involving student/student groups, 23.1% lasted between 0-10 seconds, compared with 7.6% of the student/teacher interactions lasting only 0-10 seconds.

Student initiated interac-

tions lasted less than 180 seconds more than did teacher initiated interactions. Eighty-four percent of all 180 second interactions were student initiated.

As the duration of the interactions increased, group size also increased. (see figure 2)

Students initiated twice as many interactions as did teachers. Of all interactions, 54.4% were student initiated, compared with 27.5% that were teacher initiated. Students usually initiated student/student groups (85.8% of all student/student groups were student initiated), whereas teachers more often initiated student/teacher groups. (51.3% of all student/teacher groups were teacher initiated).

Student/student groups were student terminated 84.4% of the time. Students/teacher groups were teacher terminated 42.1% of the time, and student terminated 29.9% of the time. Interactions which were both student initiated and student terminated accounted for 45% of all interactions.

Furniture was in use in the great majority of the observations (90% of the total observations involved the use of furniture). Individual teachers used furniture proportionately the same as did individu-

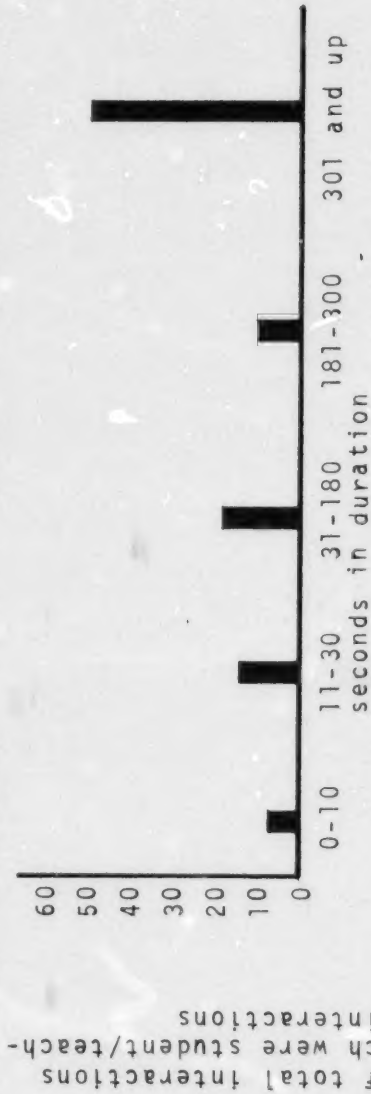


Figure 1

al students (87.1% of the time an individual teacher was observed, she was using furniture; 90.4% of the time an individual student was observed, he/she was using furniture). When fixed markings and readings were in use, furniture was usually also in use. Of the observations involving the use of fixed markings and readings, 91.1% (mean percentage) involved the use of furniture.

Portable markings and readings were used frequently with 68.1% of the total observations involving the use of portable markings and readings. 85.1% of the use of portable markings and readings was by individuals. However, when groups were in session, approximately 2/3 of both student/student and student/teacher groups observed were using portable markings and readings. Of student/student groups, 68.5% were observed using portable markings and readings; and of student/teacher groups, 72.6% of those observed were using portable markings and readings.

Portable markings and readings were used for five minutes and longer more often than for any other duration period (35.1%). Of the use of portable markings and readings, 93.3% also involved the use of furniture.

Portable markings and readings and materials non-cyclical were often used together. Of the observations involving the use of portable markings and readings, 77.9% also involved the use of materials non-cyclical. Conversely, of the observations involving the use of materials non-cyclical, 93.0% also involved the use of portable markings and readings.

Interactions involving the use of materials cyclical were more often student initiated than teacher initiated. Of the interactions involving the use of materials cyclical, 54.8% were student initiated, and 18.2% were teacher initiated. Interactions involving the use of materials cyclical were also more often student terminated than teacher terminated. Of the interactions involving the use of materials cyclical, 52.8% were student

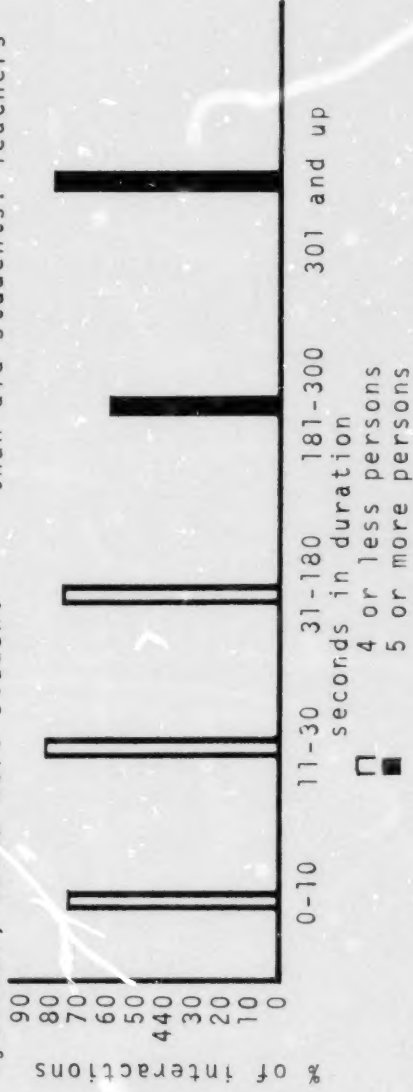


Figure 2

terminated, whereas only 25.8% were teacher terminated.

Interactions involving the use of materials cyclical lasted for five minutes or longer more often than for any other duration period (33.3% of the interactions involving the use of materials cyclical lasted five minutes or longer).

Materials non-cyclical were used by individuals more often than by groups. Of the total observations involving materials non-cyclical, 88.9% involved use by individuals. Materials non-cyclical were usually used in conjunction with furniture. Ninety-five percent of the time materials non-cyclical were in use, so was furniture.

Teachers used architectural elements/confiners for a greater percentage of the time than did students. Teachers

were using architectural elements/confiners 54.5% of the time they were observed, whereas only 16.3% of the time students were observed were they using architectural elements/confiners.

Materials non-cyclical were usually in use when there was 90% involvements on the part of the students in a teacher initiated activity (73.7% of the observations with 90% involvement showed materials non-cyclical to be in use). Portable markings and readings were also usually in use when there was 90% involvement (80.3% of the observations of 90% involvement showed portable markings and readings to be in use). Movement never occurred when there was 90% involvement (0.0% of the observations of 90% involvement showed movement).

Most movement occurred individually, rather than in groups. Of all observations of movement, 88.1% showed the movement to be by individuals.

No conclusions can be drawn about the difference between days of the week because of the unequal amount of taping times throughout the weeks due to school schedules and equipment breakdowns. Information concerning the time of day was not included because of the unequal lengths of the

breakdowns of the school day.

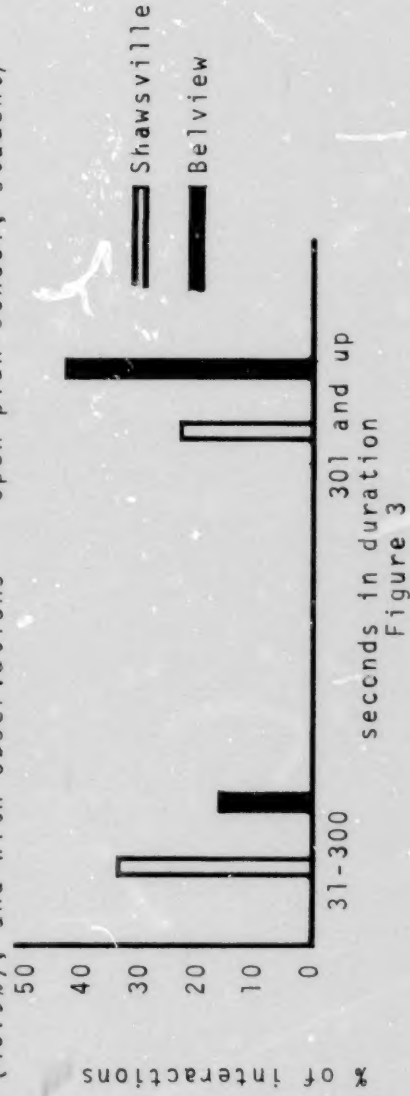
Due to the negligible number of observations of staff, administrators, visitors, fate, audiovisual equipment, personal objects and supporting architectural elements and confines, no results pertaining to them were considered significant.

The following findings were controlled for school only.

Small group (2,3, and 4 persons) interactions occurred with greater frequency in Shawsville than in Belview Elementary. Of all small group interactions, 66.7% occurred in the open-plan school, whereas only 33.2% occurred in the fixed plan school. The opposite trend was found to be true for observations of one person, with Belview having slightly more (53.1% of all individual interaction) than Shawsville (46.9%), and with observations

of interactions involving 11 or more persons. Belview had 56.9% of the large group (11 or more persons) interactions, while Shawsville had only 43.1%.

The two schools had approximately the same percentage of 0-30 second duration interactions, with Shawsville having 39.2% of its interactions lasting 0-30 seconds and Belview having 38.5% of its interactions of that length. However, Shawsville had twice as many 31-300 second duration interactions as did Belview, which had the greatest percentage of interactions lasting for five minutes or longer. (See figure 3) Student/teacher groups lasting five minutes or longer occurred twice as frequently in Belview as in Shawsville. In the fixed plan school, 78.6% of all student teacher groups lasted five minutes or longer, whereas in the open plan school, student/



teacher groups lasting five minutes or longer accounted for only 45.5% of such groups.

The students in Shawsville Elementary initiated and terminated a proportionately greater percentage of interactions than did the students of Belview. Of all interactions, 62.8% in Shawsville were student initiated, and 64.7% were student terminated. In Belview Elementary, only 37.2% of all interactions were student initiated, and 48.3% student terminated.

The use of educational and Environmental resources differed between the two schools. Students in the open plan school used furniture to a lesser extent than did students in the fixed plan school. Eighty-six percent of the use of furniture in Shawsville was by students, while 94.1% of the use of furniture in Belview was by students.

was by students.

With regard to the resource categories, (1) portable markings and readings, (2) materials non-cyclical, (3) architectural elements/confiners, (4) materials cyclical, and (5) fixed markings and readings, Shawsville generally showed a greater use than did Belview. (See figure 4)

Architectural elements/confiners were used in conjunction with portable markings and readings more in the open plan school than in the closed plan school. In Shawsville, 45.3% of the time AEC were used, PMR were also used. In Belview, on the other hand, only 34.6% of the time AEC were used, PMR were also in use.

Students in Shawsville initiated those interactions using materials cyclical twice as often as did students in Bel-



Figure 4

view. Of all the interactions involving the use of materials cyclical in Shawsville, 70.5% were student initiated. Only 39.1% of such interactions in Belview were student initiated. The same pattern held constant with regard to the initiation by students of interactions involving the use of fixed markings and readings. Only 40.0% of the interactions involving the use of fixed markings and readings were student initiated in Belview, while 67.2% of such interactions were student initiated in Shawsville.

Materials cyclical were used in interactions of short duration (0-180 seconds) more in Shawsville than in Belview, where materials cyclical were usually used in durations of 301 seconds and over. In Shawsville, 67.0% of the interactions involving the use of materials cyclical were 0-180 seconds in duration, and 20.2% of such interactions lasted 301 seconds or longer. In Belview, only 24.7% of the interactions involving the use of materials cyclical were 0-180 seconds in duration, while 60.1% of such interactions lasted 301 seconds or longer.

In the open plan school, use of materials cyclical was terminated three times more often by students than by teachers, while in Belview, the termin-

ations were evenly distributed. In Shawsville, 60.2% of the interactions involving the use of materials cyclical were student terminated, and 19.4% were teacher terminated. In Belview, 41.4% of such interactions were student terminated and 36.7% were teacher terminated.

Teachers in Belview used fixed markings and readings twice as often as did teachers in Shawsville. Of the total observations of teachers, 14.5% in Belview involved the use of fixed markings and readings, and only 6.8% in Shawsville involved the use of fixed markings and readings. Belview also had more student/teacher groups which used fixed markings and readings than did Shawsville. In Belview, 49.5% of the total use of fixed markings and readings was by student/teacher groups. In Shawsville, 39.5% of the total use of fixed markings and readings was by student/teacher groups. Shawsville, however, had more student/student groups using fixed markings and readings than Belview. Of the total observations of student/student group use of fixed markings and readings, 58.8% was in Shawsville, and 42.2% was in Belview.

In Shawsville, fixed markings and readings were most often used by the individual, where-

as in Belview, the use of fixed markings and readings was most often by groups of five or more persons. In Shawsville, 75.4% of the total use of fixed markings and readings was by individuals, while in Belview 62.2% of the total use of fixed markings and readings was by groups of five or more persons.

Belview used fixed markings and readings in combination with architectural elements/confiners more often than did Shawsville. In Shawsville, 46.4% of the time fixed markings and readings were in use, architectural elements/confiners were also in use. In Belview, the percentage was 58.5.

The fixed plan school engaged in activities in which 90% or more of the students participated in a teacher initiated activity much more often than did Shawsville. Of the total

observations, only 4% in Shawsville showed 90% involvement, while 31.3% of the observations in Belview evidenced 90% involvement.

There was more movement in the open plan school than in the fixed plan. Of the total observations, 9.2% in Shawsville involved movement and 5.3% in Belview involved movement.

Interactions in circulation areas were student terminated more often in Shawsville than in Belview. In the open plan school, 76.4% of all interactions in circulation were student terminated, whereas in the fixed plan school, 42.6% of all interactions in circulation were student terminated.

Interactions in multi-locations were found more often in Belview than in Shawsville. Of all interactions, 26.6%

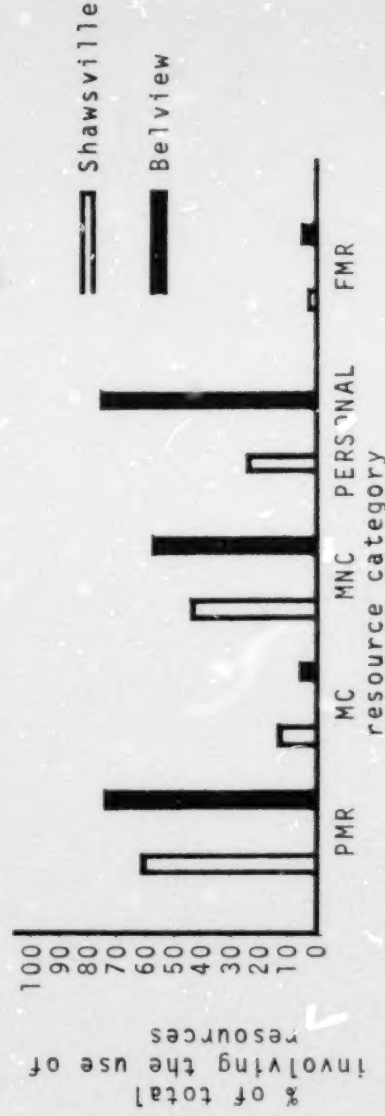


Figure 5

were in multi-locations in Shawsville, and 72.5% were in multi-locations in Belview.

The following results were controlled for grade only.

The first grades had twice as many interactions as the fourth grades, with 61.3% of all interactions occurring in the first grades and only 38.7% occurring in the fourth grades. The first grades had more small (2,3, and 4 person) groups than did the fourth grades. In the first grades, 59.2% of all observations were of 2,3, and 4 person groups, while 40.8% of all observations in the fourth grades were of small groups.

More heterogeneous groups were student initiated in the first grades than in the fourth grades. Of all heterogeneous groups in the first grades, 75.1% were student initiated.

Of all heterogeneous groups in the fourth grades, 59.1% were student initiated. The fourth grade classes of both schools evidenced student/teacher interactions of longer durations than did the first grade classes. Of all student/teacher groups in the fourth grades, 74.6% lasted five minutes or longer, while only 49.5% of such groups lasted five minutes or longer in the first grades.

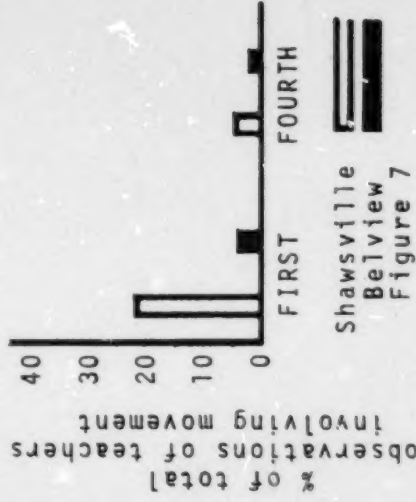
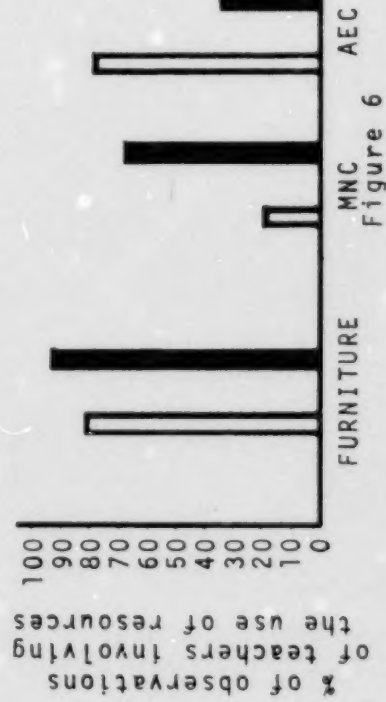
Of all observations involving the use of portable markings and readings, materials non-cyclical, and personal objects, the fourth grades use was greater than that of the first grades. The first grades did, however, make greater use of materials cyclical. (See figure 5)

Fourth graders used fixed markings and readings in combination with architectural ele-

ments/confines more often than did first graders. In the fourth grades, 66.2% of the time FMR were in use, AEC were also in use. In the first grades, only 38.9% of the time FMR were in use were AEC also in use.

Not only students, but teachers as well were observed using resources within each of the four areas. Whereas the first grade teachers were observed to make greater use of architectural elements/confines, fourth grade teachers used a proportionately greater amount of the other resources. (See figure 6)

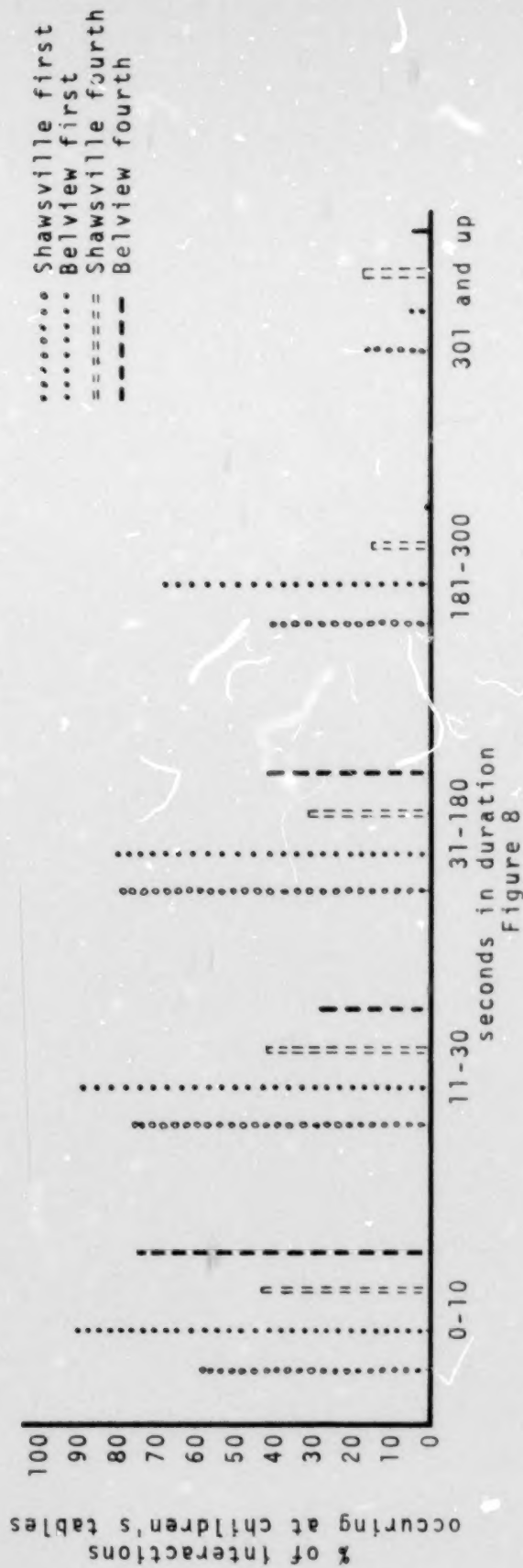
The first grades showed slightly more movement than did the fourth grades. Of the total observations in the first grades, 7.5% involved movement. Of the total observations in the fourth grades, 5.3% showed movement. Shawsville's first



grade was the only one of the four groups taped that had moving interactions with any frequency. (See figure 7)

First graders engaged in activities in which 90% or more of the students participated in a teacher initiated activity more often than did fourth graders. The first grades accounted for 66.2% of the observation of 90% involvement, while the fourth grades accounted for only 37.8%.

In the first grades, most interactions of all durations (except those longer than five minutes) occurred at children's tables. (See figure 8)



The results of our study point to three general conclusions. Firstly, the open plan school design appears to facilitate the interaction patterns of the school systems philosophy better than the fixed plan. This conclusion is substantiated by the fact that Shaws-ville demonstrated much small group behavior (twice as much as Belview), peer instruction and student-initiated activities; whereas Belview demonstrated either the entire class working as individuals on identical, teacher initiated activities or in large groups, for almost all of the observations. These student-teacher groups in Belview lasted for five minutes or longer twice as often as did student-teacher groups in Shawsville, indicating that in Shawsville, the teacher is used as a resource by the students, and not solely as an instructor. Although there is no difference between Shawsville and Belview in the number of 0-30 second duration interactions, (the quick comments from student to student that are found in any classroom situation), Shaws-ville had twice as many 30-300 second interactions as Belview. This medium duration interaction time between two students in Shaws-ville indicates the practice of peer group instruction and of co-operative student work in discovery, discussion

and assimilation of the resources which are available to them.

These figures point out that the open plan school did in fact better achieve the goals of learning by doing, peer group instruction and child oriented learning better than the fixed plan school. The question is then open as to what elements of this architectural design lead to these desired activities. This study has been an attempt to provide the information from which educational and architectural designers can begin to answer this question, and can begin to develop criteria for future design based on the use of existing facilities. Our data suggests that the practice of open education in an architecturally open plan school can lead to a learning environment in which the students are more aware of the many types of resources (including teachers) which are available to them, and can and will take the initiative to make use of those resources more than will students in a fixed plan school.

The second conclusion drawn from our data is that there was more use of the available physical resources in the open plan school. The one exception to this was the use of portable markings and readings, which

discussion

was the same in both schools.

In the fixed plan school, each student had an assigned desk where he spent the majority of the day. This small desk housed all of that particular student's personal belongings as well as a large portion of his learning resources (text-books and writing instruments which fell into the classification portable markings and readings, and paper for writing purposes). It was our observation that the child ordinarily used only those materials housed in his desk.

On the other hand, while a child in the open plan school did have "his desk" in which to house personal objects, this desk was not a permanent seat, nor was it a storage place for learning materials classified as portable markings and readings. The child in the open plan school would be found in many different locations throughout the day, as he had to venture out into the peripheral areas of his learning environment in order to obtain and utilize learning resources. We believe this difference between schools in the function of desks has a great deal to do with the disproportionate use of available physical resources.

Comparatively, Shawsville used more architectural ele-



ments and confines (which in our data turned out to always be the floor) than did Belview. This can be attributed to the greater amount of movement in Shawsville and to the fact that the wall to wall carpet present in the open plan classrooms in Shawsville allowed the occurrence of learning groups in literally every area of the space. Belview, on the other hand, had carpeting, a six foot by

eight foot rug, only in the reading corners. A rug of this dimension will not afford enough space to accommodate more than a few children at one time; hence the minimal use of architectural elements and confines in the fixed plan school.

Materials non-cyclical were also utilized more in the open plan school, in spite of the fact that from our observations

it was our opinion that Belview emphasized the use of textbooks (the prevalent material non-cyclical) more than did Shawsville. Hence, the overall greater use of materials non-cyclical in Shawsville evidenced an independence from textbooks and a corresponding greater use of learning materials other than textbooks.

The open plan school also demonstrated a higher use cycle for materials cyclical. Shawsville frequently had small group demonstrations in which such things as felt boards and magnetic boards were used. These types of materials were also available in Belview, but the large group orientation of Belview's classes prevented the use of these types of materials to any great extent. Other types of materials cyclical such as globes, fishtanks and prepared reading packages were used more in Shawsville because of the freedom the students appeared to have to be involved in activities separate from the rest of the class. The use of materials cyclical was two times as likely to be student-initiated in Shawsville as in Belview.

The use of fixed markings and readings was also initiated by students two times more

often in Shawsville than in Belview. In fact, the overall use of fixed markings and readings was two times as great in the open plan school in spite of the fact that Belview had far more teacher-at-the-blackboard type assignments than did Shawsville. This is evident from the fact that the teachers in the closed plan school used fixed markings and readings more than the teachers in the open plan school.

All of this information seems to indicate that the teachers in the fixed plan school were found to be dictating the use of physical resources, while the students in the open plan school had more initiative in their use of resources and the physical environment. We feel that this difference was not due to the individual teacher's control or lack of control, but that it reflects the students' awareness of and use of the learning environment. The students made better use of the open plan school, an environment which provided a variety of spaces and activities, and which afforded a freedom of movement, interaction and activity associated with the lack of architectural confines and educational restrictions in open education.

The third general conclusion, indicated by the study's

results, was that the first and fourth grade interaction patterns may necessitate different design requirements for physical space. It may be well to note here that this conclusion was inserted in the study only after all data was collected. This was not a focal point at the project's conception but proved itself to be a design factor which is possibly ignored in both the school's architectural and educational designs. The particular age of a child, in most if not all cases, dictates the range (majority) of both his physical and mental behavior.

As was frequently indicated by our observations, the first grade student tended to physically move about (run, jump, skip, walk) in his "classroom" environment to a greater extent than did the fourth grade student. The first grade student was repeatedly engaged, as witnessed on videotape, in a wider range or short term, transitory behavior than was the fourth grade student whose activity was usually teacher initiated and directed towards sitting behavior which generally lasted for a duration of five minutes or longer.

It was witnessed that not only the six year old child,

but his adult instructor as well, moved about in the educational environment freely and continuously to a much greater extent than did the adults and students in the fourth grades. Fourth grade teachers were observed using more furniture than were the first grade teachers who, in their "classroom" situations, were in continual contact with architectural elements and confines (which always turned out to be the floor) denoting constant movement from one area of the room to another.

Requirements for the size and quality of physical space would appear to be a function not only the degree of movement within the area, but of type and number of participants engaged in movement or activity. First graders were statistically evidenced as engaging in twice as many interactions as were fourth graders. The interaction pattern found to be most common among the first graders was that of a small group of 2 or 3 persons, generally engaged in either co-operative play or clustered about an educational resource. The fourth graders, on the other hand, often worked individually, or assembled in relatively large

(11 persons or more), stationary groups for learning experiences and classroom activities. In essence, both the necessary and repeatedly used space in the fourth grade classes was that area immediately surrounding the large cluster of children's desks, while in the first grades, the student moved from desks to the outer most periphery of the room.

The preceding data would seem to indicate that the classroom should be designed with the differences between these two types of activity patterns in mind. The fourth grade area needs to provide for individual work and for the easy assembly and functioning of relatively large groups. In the first grade, the classroom should be in keeping with the great number of small group activities of short duration and the continual movement that are found to be consistent with the behavior and learning patterns of the first grade student.

Retrospective considerations fall into three categories. The first is the implementation of an ethnological study in an existing school system. Ample time should be given in the inception of the project so that there will be no last minute changes from that end. Also, if at all possible, the selection of schools that have been in use for the same amount of time should be added to the matching criteria so that the data will not be affected by the variable of years of operation.

Secondly, the equipment should be thoroughly checked for quality of results and should be replaceable, because it will break down. (Our data showed that video-tape equipment usually breaks down on a Thursday.) We found specifically that we should have had the advantage of one inch videotape rather than the half inch, to afford increased picture quality. We found also that we should have allowed two weeks extra taping time to make up for the equipment breakdowns, or, if possible, have had a duplicate set of equipment available. The environmental instrument pairs should have been of equal caliber, and each group member should have had a more comprehensive checklist, including the following: if the lights were on, if the windows were open, and

if the air-handling systems were on.

The third category for necessary change was in the handling of the data. Our categories were not oriented well enough to our questions. For example, on the computer print-out, we couldn't differentiate a portable blackboard from a book, or art materials from writing materials, due to the nature of our categories. Duration of information should have been less specific; long, medium and short categories would have sufficed. And, lastly, the data interpretation should have been done by the group as a whole so that everyone would be aware of the total scope of the results.

retrospective consideration

Interpretations for design criteria

Our presentation of our research has so far been based on the objective results of the study of activities within two normal classroom environments. We have made an effort in the reporting sections of this paper to present and discuss the project and results without interjecting any personal opinion or bias. However, as designers, we recognize a great need for evaluation of existing conditions on the level of interpretation, not just presentation, of facts. We have presented three general conclusions, but we haven't presented our interpretations of why these types of interaction and use patterns exist, and what decisions they help educational and architectural designers to make. In this section, we are presenting our interpretations of our study, with an emphasis on material which may be useful to the designers of educational environments.

We feel that the physical environment is little recognized in its major role in educational systems. We feel that too often the integral relationship of the educational curriculum and the educational facility is overlooked within the school system because of a lack of understanding of how the physical layout of the school influences the

use of the physical resources. The two schools that were studied point out how the type of classroom and the arrangement of the classroom was a major element in defining the use of the physical resources.

The county school board and the individual schools began the definition of the interaction and use patterns by specifying educational materials. Montgomery County encouraged the use of resource centers and learning packages such as SCIS, a small group and experiment-oriented science program. In all four classes studied, the skill subjects such as math and language arts were broken into homogeneous groups of students in order to allow teachers to concentrate on the specific problems shared by a small group. In both first grades, title one teachers were employed to work with slow readers.

The buildings defined the physical limits of the activities. In Belview, each class had a defined room in which to coordinate all activities, and the hall was used as a spill-out area. In Shawsville, each class or group of classes was assigned to spaces which were defined by exterior walls, and, in the interior of the building, by rows of storage units and circulation paths. To accommodate a spill-over activity,

the interior boundary of the space could deform and change.

The third important factor influencing the classroom data was the teacher's interpretation of her school's philosophy and goals. This factor included how she arranged the desks, how she set up the resource centers, and what defined the circulation paths in her given area. We will offer an analysis of these three defining elements in each of the four areas that were studied in an attempt to determine what effect these factors had on the interaction and use patterns that were established. (For reference, see layout plans in the environmental section.)

Shawsville first grade was unique among the areas studied in that there were two teachers and the equivalent of two classes within a space twice as large as a regular classroom. However, the area filmed was equivalent to each of the other areas. This space was bounded by a wall of storage units on one side and included a wet area that was partially divided off from the main part of the room by storage units. Groups of six desks each were arranged in different shapes and at different angles to each other and to the space boundaries. The students didn't have permanently assigned

desks, so they were free to change areas frequently throughout the day. This type of arrangement created a small group feeling and was probably a major factor in the cooperative small group activities that took place in Shawsville. Resource centers were located along the boundaries of the space and were defined by easels, chairs, desks, and storage units. The irregular desk arrangement created pockets that helped define areas for small groups of students to be involved in resource related activities which were apart from the mainstream of activity. The wet area, containing sinks, plants and guppies, was an attraction because of its many and varied resources. The circulation path which resulted from this varied layout of activities did not dictate specific routes. A student could pick a number of ways to get to a place and could pass ever-changing groups of people and activity on the way. Thus, in this first grade, the desk arrangement allowed and encouraged the students to interact; the circulation paths were an integral part of the educational program because of the resources and activities with which they brought the students in contact; and the resource centers were easy to get to and to use.

In Belview first grade the main activity area was the center of the classroom space, and was divided into two groups of ten desks each. The size of this group seemed to resist interaction: we observed mostly individual and large group interactions. There were very few two or three people interactions as compared with the number that occurred in Shawsville. It is possible that ten is too large a number for a small group feeling, and inhibits small, private conversations within the group. Thus, the arrangement of the desks in groups probably tended to limit small group interaction. The resource centers were several single desks containing cyclical materials for use by one person at a time. The wet area was a boundary of the main class area, and thus was not separate from the mainstream of activity. The circulation pattern in the classroom was therefore very predictable; there was not the continuing change of activity areas as in Shawsville. One could always expect to pass the same people and the same activities in the same places.

The fourth grade in Belview Offered a more flexible layout than the first grade, and several of the steps toward opening up the classroom had been



taken. Although the desks were arranged in rows of four and five (linear rows tending to resist small group discussion as shown by less two and three people interactions than in Shawsville) the room was divided so that the main activities took place in the front of the room and small groups could break away to the back of the room with a degree of privacy. There were three resource centers for

three to four persons, rather than individual resource centers as in the first grade. The circulation was a little less predictable because one row of desks was arranged perpendicular to the others; and because small groups of students would periodically work in different areas of the room.

The fourth grade in Shawsville was bounded by one wall, two rows of storage units, and a

major circulation path for the school. The fourth and fifth grades shared their various spaces and a wet area for different activities, and therefore the students were moving to different areas and desks throughout the day. The desks which were larger than those in the first grade, were in groups of six and five. They were at angles to each other, which prevented this arrangement from appearing too fixed. The circulation path was somewhat unpredictable because of the open and closed spaces caused by the angles of the desks and the obstruction of the path by a circular resource center. The resource centers were for groups of three to four students and the language center was divided by a portable blackboard from the rest of the space.

These descriptions of the spaces demonstrate how the classrooms could be conducive to interaction between students as a result of the way that the teacher laid out her space. Smaller groups of desks, as opposed to rows, small group oriented resource centers which are located out of the mainstream of activity, and varied circulation paths are ways to induce a wider range of interaction and student initiative in the use of the physical environment. The lack of physical boundaries in

the open plan school was an essential element in allowing the teacher to determine this kind of layout.

The use pattern of physical resources was determined by a combination of the room layout with the way that the resources were made available. In Shawsville, the resource categories, which included architectural elements and confines, fixed markings and readings, materials cyclical, and materials non-cyclical, were used at least twice as often as they were used in Belview.

Portable markings and readings, the traditional pens and books, were used equally in both schools. The significance of these facts is that in the open plan school, the traditional learning resources are being complemented by the students' use of additional learning resources. The open school provides an environment in which the students, usually on their own initiative, make use of all the various resources that are available to them.

In the use of architectural elements and confines, (which in every observed case was the floor), Shawsville definitely had an advantage because it had wall to wall carpet which was available for use by individuals and groups in every part of the room. The small area of carpet in both Belview class-

rooms pointed to the advantage of carpet in the classroom: small group activities that were separate from the mainstream class activities took place on these small carpeted areas, and thus a certain degree of separation was achieved in the fixed classroom.

The fixed markings and readings, usually blackboards and bulletin boards, were used mostly by students in Shawsville, whereas they were used mostly by teachers in Belview. The blackboard was used mainly for giving assignments in Belview, but in Shawsville the blackboards were learning resources that were used by students who were working on assignments or were explaining problems to one another. This difference in use was explained not just by the individual teacher's methods, but mainly by the way that the blackboards were made available.

In Belview there was one wall of blackboard which was the focus of the room arrangement. The teacher would collect the class' attention at the blackboard, and thus it was a rather formal space. In Shawsville there were two walls of ceiling to floor blackboard panels, plus the blackboards on the back sides of some of the storage units. There wasn't any one focus to the space, and thus the blackboards were available for informal use by

the students for a variety of activities. A less formal area would seem more inviting and thus more likely to be used by small student groups than a focus area for mainstream activities.

The other categories of learning resources also demonstrate the difference between use and lack of use in terms of the way that they are made available. In Shawsville materials cyclical materials noncyclical, and portable markings and readings were kept in portable storage units which contained shelves and cabinets. These storage units combined with easels, pillows, chairs, tables, walls, and rugs to form the small group areas. The materials were therefore readily available in the areas in which they would be used. In Belview the storage shelves and cabinets were fixed elements that were separated from the main activity area by circulation space. These learning resource types of materials were either passed out to each student for use at his desk, or he would collect the items from their storage spaces and return with them to his desk, therefore treating the materials as formalized and dictated activities. The spontaneity of interest in these materials was lost when they were passed out, instead of simply being made available. In the open plan

school, students were invited into activities as part of the real world around them. In the fixed plan school, students work with specified activities and materials.

The results of the study also pointed to different space requirements for the first and fourth grades. The first graders were, because of their age and inexperience with school, unable to concentrate on any one activity for a long period of time. Shawsville's first grade was constantly moving and interacting. Because of the fixed plan school's tendency towards large group and/or individual types of activities, the Belview first graders were usually sustained in long periods of similar activity, although they also had relatively short interest spans. Compared to the first graders, both fourth grades demonstrated the ability to work on individual, small group and large group projects for long periods of time. It should be noted that Shawsville's fourth graders spent their first three years in fixed plan schools, and therefore were probably greatly influenced by their backgrounds in their use of the open plan school. However, whether or not this was a major factor in the similarities between the two fourth grades, it is evident that the fourth graders are capable of

more sustained activities than the first graders. The fact that Shawsville's fourth grade shared various spaces and a wet area with the other fourth and fifth grades points out that the fourth graders, perhaps unlike the first graders, who were not given the opportunity to share spaces, are capable of involving themselves in activities in several different spaces.

All this seems to suggest that different age groups need different spatial requirements and design considerations. First graders would seem to need a large self-contained space that allows a continual flow of activity among small groups. A first grader may need the security of viewing the wholeness of his area. The fourth grader, on the other hand, needs to be able to work individually, in small and in large groups, and is capable of moving into different areas for the different activities in which he is involved.

We see the educational materials, the building, and the educational community's interpretation of what they are trying to do as the substance of the two schools we have studied, and of all schools, everywhere. There are so many decisions that are made before the final end pro-

duct, the student, emerges from the school system, that the task of defining the process and controlling the input is infinite. But it is our belief that the interaction of the work of researchers, educators, and designers, cannot help but contribute to a better school and a happier and more successful student.

environmental results

The environmental data reveals very different environmental backgrounds for the four spaces filmed. The two open plan spaces tended to have a more controlled environment, while the two closed plan spaces had a wider range of conditions. One of the key factors was the different treatment of windows in the design of the school. Belview had a row of high windows along its exterior walls with interior venetian blinds as sun control. Shawsville had only a few narrow windows along each side that were fixed glass, recessed into a special wall condition which provided an exterior sun control. Another key factor was the age of the systems equipment. Belview fourth grade was about 20 years old, Belview first grade was 8 years old, and Shawsville was in its first year of operation. We will discuss these factors in terms of the light, air, and sound conditions that were studied for each space.

The lighting system was studied in two categories: the amount of light that reached a child's desk, a daily measurement; and the reflectance value, measurements based on inherent values of materials in the school room.

The amount of light recorded reaching a child's desk depends on proximity to the source of artificial and natural light. These overall averages and extremes give a general picture of the systems differences.

	Averages	Low	High
Bel 1	100-343	32	2000
Bel 4	57.1-90.1	6	500
Sha 1	65-71.46	40	100
Sha 4	72.7-77.7	42	100

The windows at Belview definitely added more than the 70 ft. candles that, in the properly designed environment, is enough to adequately read pencil handwriting. Shawsville has a tight range around 70 ft. candles. The first grade in Belview was on the south east side, thus receiving an immense amount of sun in the morning which the blinds were not sufficient to control. The fourth grade in Belview faced north; but, unfortunately, a silver construction trailer was situated right outside the window and reflected light in, giving the space

a constant glare. The very few windows in Shawsville had both the outside sun control and the inside vertical blinds.

The oldest system, Belview fourth grade was the least efficient in giving enough light. Only six incandescent bulbs, one of which didn't work during our study, three rows of six fluorescent fixtures each, covered more of the room area; however, three of these were out by the time we had finished our study. These lights also noticeably buzzed. Shawsville's recessed lighting gave the most even coverage although there were darker pockets around the exterior walls in the space. This problem, common to all the four spaces, is discussed in the NFL study, Contrast Rendition by K. Sampson. The system dropped off at the blackboards and sidewalls, which reduced the effect of the reflectance factors: we found the lowest Shawsville values near the blackboards. Contrast Rendition suggests a secondary system around the periphery of the room to allow a more uniform level of illumination, to light the blackboard and side walls more efficiently and to increase the amount of reflected light thus increasing the visibility of pencil handwriting near the black-

board. In conclusion, Belview locations were most affected by proximity to the windows, while Shawsville locations were affected by placement in relation to the ceiling grid of lights.

The second type of measurements taken can be cross-referenced with the reflectance criteria established by both Contrast Rendition and American Standard Guide for School Lighting by the Illuminating Engineering Society. This criteria was established to equalize dark and bright areas as much as possible in order to reduce eye adaptation to sharp changes. The most important surface is the desk top which is closest to the task (assuming a student is working at a desk). This should be between 35%-50% and non-glossy. Those desks in Belview first grade and Shawsville fourth grade were both too low: 25%. Shawsville first grade was acceptable with 39.4% while the desks in Belview fourth grade varied from 22% to 50%. Many of the desks in each school had glossy tops. Because the secondary drop for the head-down-and-reading position is the floor, it should also be as light as possible: 30% to 50%. The Shawsville rugs were an unacceptable 11.7%. The tile floors of Belview were only 21% and 17.3%. Colored chalkboards should be 5%-10%.

Belview first grade's was 11.1% and, fourth grade's was 8% which were both acceptable. Walls require 40%-50% reflectance with Shawsville first and fourth grades at 44%-54% and Belview first grade at 55% fulfill. Belview rooms should have had over 60% reflectance for their window walls to help reduce the effect of the window brightness. From the ft. candle data, we found that over 10 times the light needed at a desk came in the window which is unacceptable. Also unacceptable is that any reflectance value be less than one third the task brightness which was the case with all four floors.

The air handling systems were also broken down into two categories: the air temperature and relative humidity, taken every day, and the air velocity taken on one day. The overall averages on the first category are as follows:

Dry Bulb

	Average	Low	High
Bel 1	76.7	77.7°	69° 85°
Bel 4	71.4	75.1°	63° 81°
Sha 1	69.1	74.5°	63.7° 79°
Sha 4	69°-74.5°	68°	77°

Relative Humidity

	Average	Low	High
Bel 1	34.2%-40.4%	22%	62%
Bel 4	39.6%-44.4%	21%	81%
Sha 1	46.8%-56.0%	39%	73%
Sha 4	33.3%-37.7%	28%	58%

The outside temperatures ranged from 50°-85° during the changeable spring weather. From the data we find that Shawsville had a more controlled and smaller range of dry bulb temperatures. Belview first grade was unquestionably the hottest room with its intense morning sun. Shawsville first grade was the most humid space. The locations near the windows were again under

the sun's influence. (See Daily Measurements and room plans) in this case with respect to dry bulb temperatures.

Referring to the system plans of the rooms, Belview had a linear supply system originating in the mechanical room near the entrance, which fed the older rooms first with the two newer rooms attached to the old system. The return system consisted of a grill either in the closet or by the door. The air flow in the hallway drew air out, except for the fourth grade classroom, whose grill was obstructed by boxes. Unless a good breeze was blowing in from outside, there was no air velocity at the desks.

Neither room had an adequate air turnover. The locations nearest the windows or the door could occasionally catch a breeze, although most locations consistently revealed no air movement at desk height. During the summer months, the radiators blew out air; however, the first grade teacher commented that her room was continuously stuffy as well as hot both summer and winter.

During the winter months, she left her windows open much of the time. This could have been caused by the fact that her radiator was eight years newer than the fourth

grade's and thus put out more air. Another factor was that her room was on the south side and received much more sun than most of the older rooms.

The Shawsville system consisted of six separate zones, each serviced by a penthouse with a fresh air intake. The system was a combined heating-cooling system designed to continuously compensate for one another. If the space became too hot, the air conditioning switched on to lower the temperature to the desired level. The system had thermostats in each space; however, the janitor sets the overall temperature as 80° in the summer and 72° in the winter. Two extreme settings on the thermostats will result in a middle temperature. There were approximately two diffusers in each classroom-equivalent space. The returns were through the lights where the air was drawn by an exhaust fan and blown out through the penthouse. Although the many construction paper mobiles from student art classes fluttered from the air currents, there was no reading of air currents at desk height. Measuring down at one foot intervals from the diffusers, we found that the air streams formed loops of decreasing

velocity from the diffusers back up to the returns. The lowest loop was about five feet high at ten-fifteen fpm. The largest loop, 150-200 fpm, was found six inches from the ceiling. It is thus our assumption that the returns were too close to the diffusers and prevented the air from circulating down at desk height. In this particular area of air control, neither school was very successful.

To obtain an accurate picture of the acoustic environment of schools, there are many variables which influence the space: the reverberation time of the space, the noise reduction factor, the speech-interference level, the articulation index, and the transmission loss on the walls. Although the expensive equipment required for an extensive study was not available to us, we nonetheless attempted to compare the general background noises and determine what influenced the sound levels in each school.

Shawsville first grade and fourth grade had an acoustical tile ceiling and wall to wall carpet. Belview first grade had an acoustical tile ceiling, and vinyl tile on the floor. Belview fourth grade had a plaster ceiling and a vinyl tile floor. Thus, the

four spaces had different types of acoustical environments.

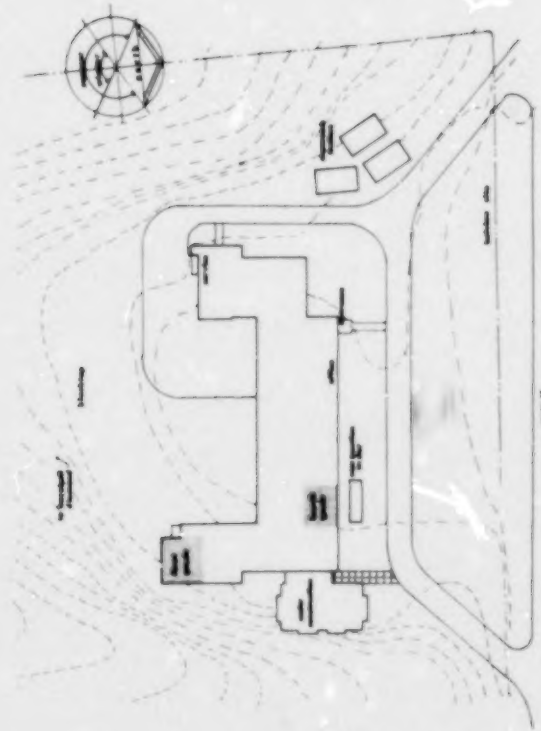
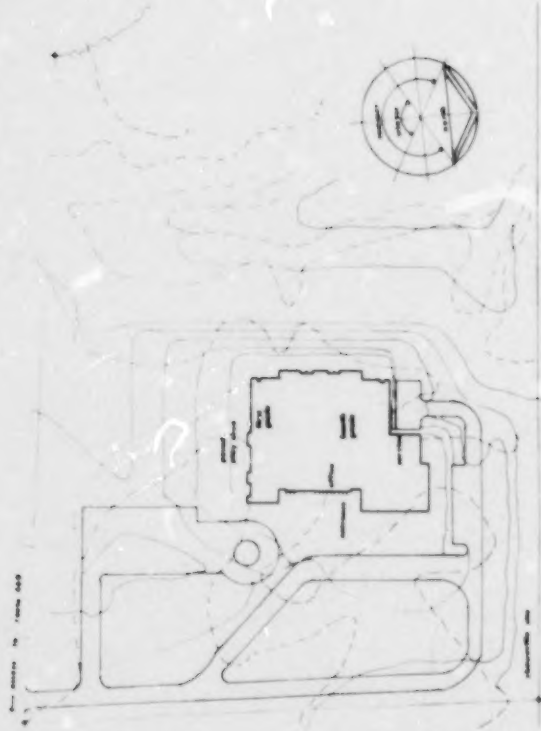
On June 12, after the videotaping data was completed, the measureable data could be taken. The two rooms in Belview had been stripped for summer. The radiator was not on, however, lights were on and four windows were opened. Only the team member doing the measuring was present. In the first grade the lights buzzed noticeably. We found three influential factors of the existing sound levels. Closing the door reduced noise between 3-23%, depending on the source of the noise. Passing cars on the busy road about 40 feet from the school raised the background level as much as 13-25%. Construction of a kindergarten addition had been taking place all spring and the secretary remarked that it had been even louder than it was on June 12. Raising the general level from 24-47%, this noise was a sporadic noise as opposed to a loud constant background noise.

Shawsville first grade was half-stripped for summer and half in use by summer school. This program, which included about 30 students and 3 teachers were spread out across the equivalent of two normal classroom areas. One light

had a buzz. As it was during our study, the janitor's closet door was slightly ajar so that one heard the water flushing. The air handling systems were working. During the afternoon measurements, the students had gone home while the teachers remained. Influential factors were the water flushing and the rug cleaning machine. Water flushing raised the level 9% intermittently. The rug machine was turned on many times during the day by the janitor: it was part of the continual maintenance of the carpet. The background noise of the space in which it was used would be increased by 54% and by 20% if it was in an adjacent area.

The background noise (without people-) was generally 12 decibels higher in Shawsville than in Belview. The windows in Belview, the proximity to the road, and the construction affected the noise level with loud intermittent noises. Shawsville windows did not open to admit noises, thus its main influential factors were interior maintenance noises.

Our inclusion of so many variables prohibited any conceivable way to correlate the micro-environment of each location with its interaction and use patterns. In lieu of such data we do find that locations near the windows in the closed plan school received the widest range of extreme light and temperature values. This would imply that further study is needed to design more controlled window conditions. Also implied are studies to determine the effect of a micro-climate with extreme ranges on interaction and use patterns as opposed to a more controlled constant climate. We also see the need for more integration between mechanical and natural systems in a case where large windows are included. Another comment we would make is that mechanical systems should be designed so as not to short circuit their own efforts.



Overall Room Averages

Daily Measurement Averages

	foot candles			dry bulb			relative humidity	
	m.	p.e.	aft.	m.	p.e.	aft.	m.	aft.
1	110.5	130	48.5	69°	72.5°	72°	33.5%	31%
a	836.1	651.5	101.4	77°	75.2°	76.7°	42.9%	41.7%
h	1500	2000	195	82.5°	79°	80.5°	57%	60%
1	65	195	162.5	69°	73.5°	74.5°	33%	30%
a	613.1	371.5	211	77.7°	76.3°	77.9°	41.2%	36.5%
h	1900	750	260	84°	80°	82°	48%	40%
1	32	48.5	65	69.5°	74°	75°	30%	26%
a	116	80.2	77.1	77.3°	77.6°	78.2°	39.7%	35.4%
h	227.5	97.5	97.5	85°	82°	83°	46%	42%
1	48.5	32	56.7	70°	74.5°	76°	30%	33.5%
a	151.8	63.1	66.9	77.6°	77.6°	78.2°	39.5%	43.3%
h	380	91	81.2	83°	82°	83°	46%	62%
1	75	48.5	65	69.5°	72.5°	73°	34%	30%
a	213.7	93.3	88.5	77.5°	76.5°	76.9°	40.1%	39.8%
h	440	130	130	83°	81°	83°	44.5%	58%
1	32	41.9	56.7	70°	75°	73.5°	34%	32%
a	135.5	82.7	62.1	77.7°	77.8°	77.9°	41.3%	37.1%
h	260	130	65	83.5°	81°	83°	48%	42%

44

39

The radiator blows out 500 cpm.
 an outside breeze added 40-60 cpm.
 the frill pulls away 10-65 cpm.
 the hallway had a breeze of 100-200 cpm.
 none of the locations had a reading at desk height.

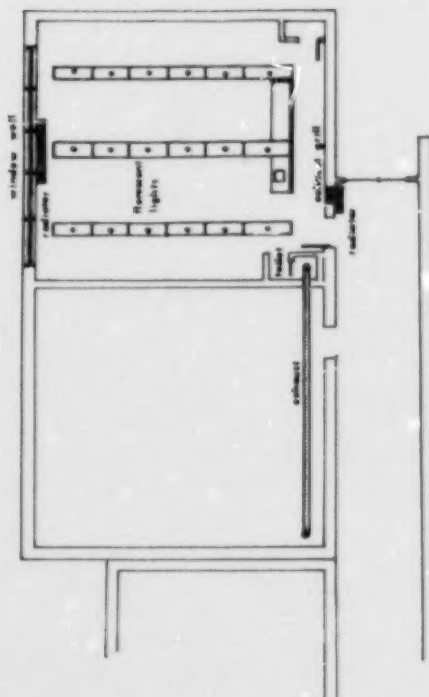
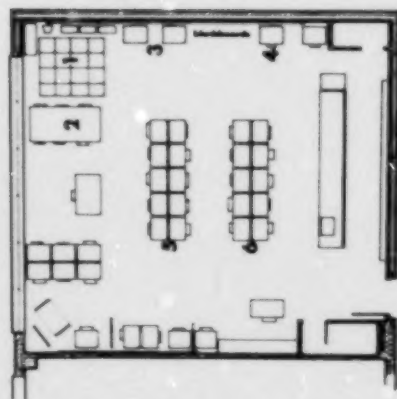
Sound Measurements

June 12: school was closed for summer; construction of kindergarten taking place.

Door Open		Door Closed	
10:32	...38db	10:32	...31db
10:37	...48db	10:37	...44db
10:42	...50db	10:42	...40db
10:47	...52db	10:47	...42db
(No construction taking place)			
1:32	...32db	1:32	...30db
1:37	...30db	1:37	...29db
1:42	...27.5db	1:42	...28db
1:47	...30db	1:47	...29db

Reflectance Factors

student desk.....	25%
teacher's desk.....	26.9%
table, wood.....	16.3%
counter.....	16.1%
art table.....	38.4%
ceiling.....	87.7%
floor, vinyl tile.....	21.5%
carpet.....	10% & 8.6%
blackboard.....	11.1%
aluminum frame.....	35.7%
brown strip above blackboard.....	14.2%
green chalkboard easel.....	22.7%
bulletin board (blue construction paper)....	33%
aluminum frame.....	44%
bulletin board (yellow construction paper)....	44.4%
wood strip - rame.....	39.9%
radiator.....	19.4%
cinderblock wall painted light brown.....	55%
wood doors.....	32.1%
gray strip frame.....	25%
wall base (black).....	11%
red portable cube.....	21.4%
scis shelves.....	52.1%
wood shelves.....	14.6%
window sill.....	28%
plastic chair.....	28.5%



Overall Room Averages

footcandles
low....40
ave....65-71.46
high....100
dry bulb
low....63.7°
ave....69.1-74.5°
high....79°
relative humidity
low....39%
ave....46.8%-56%
high....73%

Daily Measurement Averages

		foot candles		m.	dry bulb		relative humidity	
		m.	p.e.		m.	p.e.	m.	aft.
1	1 a h	58 70.7 80	70 81.5 91	68° 69.4° 72°	71° 72.9° 74°	71.5° 73.7° 75.5°	54% 60.6% 65.8%	46% 52% 60%
2	2 a h	50 66.2 73	62 70.7 78	68° 68° 68°	74° 74° 74°	74° 74° 74°	54% 54% 54%	46% 46% 46%
3	3 a h	63 66.2 72	64 69.7 75	68° 68° 68°	73.5° 73° 73°	74.5° 74.5° 74.5°	54% 56% 56%	49% 53% 53%
4	4 a h	70 80.7 100	74 80.7 100	68° 68.5° 68°	71° 74.2° 79°	74° 75.2° 76.5°	54% 56% 58%	39% 49% 56%
5	5 a h	69 72.2 75	72 76.5 80	68° 71.2° 77.5°	74° 74° 74°	74° 75.2° 76.5°	54% 56% 58%	42% 44% 46%
6	6 a h	40 49 59	40 50.5 60	69° 69° 69°	74° 74° 74°	74° 75° 75°	57% 57% 57%	46% 46% 46%
7	7 a h	55 60.7 68	57 60.5 65	63.7° 70° 73°	71° 73.5° 75°	73.8° 75.7° 78.5°	53% 54.5% 56%	47% 51.5% 56%
8	8 a h	75 81.3 90	76 78.6 80	68.7° 68.7° 68.7°	74° 74° 74°	75° 75° 75°	56% 56% 56%	50% 50% 50%

1, 6 & 8 were chosen as parameters for the space.
2, 4, 5, 7, 9 have one day's data for dry bulb and relative humidity.

Air Velocity

The five openings of the diffuser varied from 150-750 cpm with an average of 320-450 cpm. The returns in the light fixtures pulled from 20-100 cpm depending on their proximity to the diffuser.
Occasionally, air velocity in the locations would read 10-15 cpm; however, 90% of the time there was no reading at desk height.

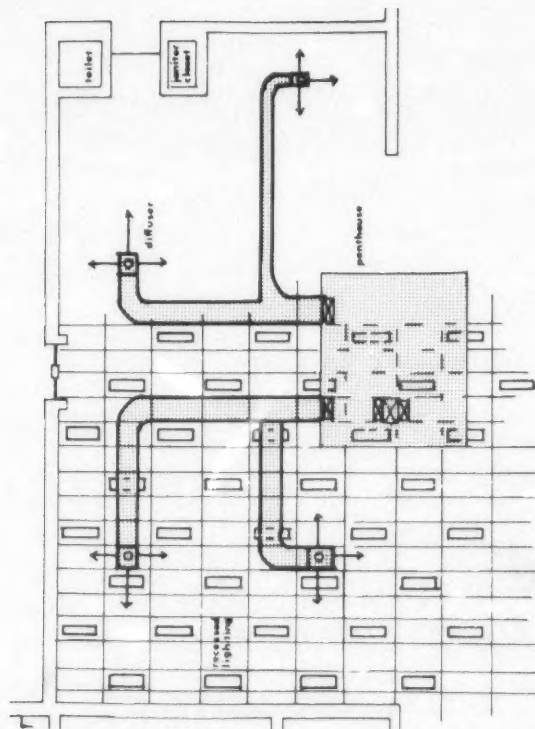
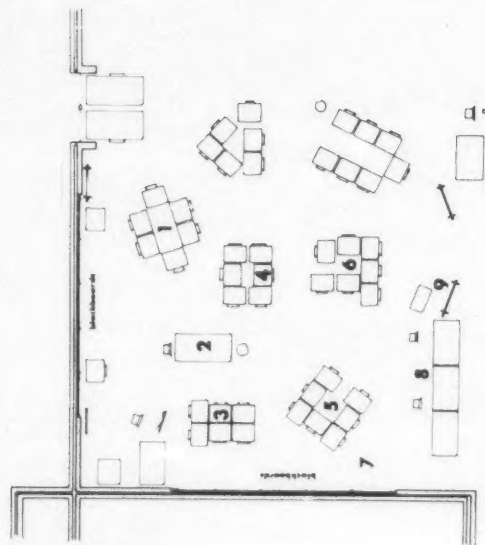
Sound Measurements

June 13: during Summer School children present.
10:30....49db
10:35....51db
10:40....48db
10:45....54db (water running)
children gone, teachers present
1:30....44.5db
1:35....44db
1:40....53db (carpet vacuum in adjacent area)
1:45....44db

Reflectance Factors

student desk, wood.....	26.22%
teacher desk.....	21.27%
circular table.....	26.92%
ceiling.....	80%
carpet.....	11.7%
cinderblock wall, painted yellow.....	44.4% to 54.4%
wall base, brown.....	13.63%
plastic strip, top of the wall, yellow.....	21.7%
blackboard, brownish.....	24.4%
aluminum frame.....	17.5%
blackboard, on the back of a portable storage unit.....	14.2%
bulletin boards tan burlap.....	25%
bulletin board, back of storage unit tan burlap.....	25%
red burlap.....	22.2%
yellow burlap.....	4.76%
many color construction paper.....	28.57%
coat rack inside storage unit.....	50%
glass window.....	157.89%
wood panel below window.....	33%
wood door.....	15%
small bookcase.....	16.6%
file.....	20.27%
chairs	
green.....	20%
black.....	7.14%
yellow.....	23.3%
olive.....	12.1%

Shawsville first grade



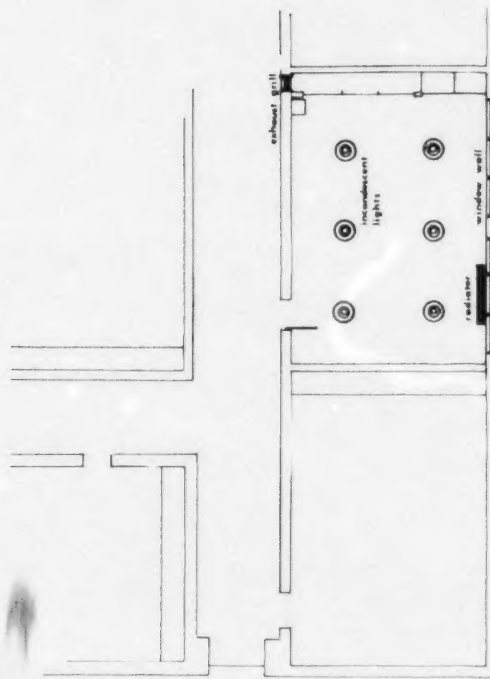
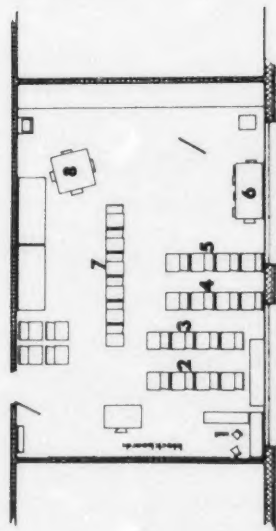
Overall Room Averages

Daily Measurement Averages

		foot candles		dry bulb		relative humidity		footcandles	
		m.	p.e.	m.	p.e.	m.	p.e.	m.	p.e.
1	a	8	12	64.5°	73.5°	34%	32%	low.....6	
		63.6	102	70°	74.3°	42%	48.7%	ave.....57.1-90.12	
	h	130	260	74.5°	76°	57%	81%	high.....500	
2	a	8	16	65°	73°	31%	30.5%	dry bulb	
		51.5	65.6	70°	74.5°	41.7%	45%	low.....63°	
	h	84.5	97	73°	76°	53%	69%	ave.....71.4-75.1°	
3	a	24	16	64.5°	73°	31%	30.5%	high.....81°	
		50.3	72.5	70.2°	74.8°	41.7%	45%	relative humidity	
	h	71.5	130	73.5°	76.5°	53%	69%	low.....21%	
4	a	24	24	65°	73.5°	32%	30%	ave.....39.6%-44.4%	
		54.9	88.8	71.3°	74.6°	40.4%	45%	high.....81%	
	h	97	195	78.5°	77°	57%	66%	Air Velocity	
5	a	32	32	65°	73.5°	21%	30%	The radiator blows out	
		75.2	64.6	72.4°	75.1°	37.3%	42.7%	350-400 cpm.	
	h	130	97	78.5°	77°	57%	66%	an outside breeze added	
6	a	41	38.6	65°	73°	23.5%	27%	40-100 cpm.	
		105.2	74.6	73.3°	74.6°	37.5%	42.2%	the grill was obstructed by	
	h	227	130	81°	77°	57%	66%	boxes.	
7	a	24	32	65°	72.5°	27%	27%	the hallway had a breeze of	
		40.8	48.5	73.1°	74.5°	37.4%	42.7%	30-100 cpm.	
	h	65	65	79.5°	76°	53%	69%	none of the locations had	
									a reading at desk height.
									Sound Measurements
									June 12: school was closed
									for summer; construction of
									kindergarten taking place.
									Door Open
									Door Closed
									10:30.....46db
									10:35.....44db
									10:40.....51db
									10:45.....51db
									1:30.....34db
									1:35.....40db
									1:40.....34db
									1:45.....34db
									(Light construction noise)

Reflectance Factors

student desk	
shiny wood.....	48.6%
dull wood.....	22.9%
linoleum.....	50%
teachers desk, wood.....	16.25%
table, wood.....	12.3%
table, shiny wood.....	35%
ceiling.....	
floor, vinyl tile.....	17.3%
blackboard.....	8%
alphabet in frame.....	9.4%
light green paper	
in frame.....	35.1%
cinderblock wall	
below waist height,	
painted dark green.....	30.5%
above waist height,	
painted light	
green.....	33.3%
all wood stripping.....	25%
wood closet doors.....	18.8%
closet glass windows.....	25.2%
radiator.....	35.2%
mirror.....	54.5%
bulletin boards (yellow	
construction paper).....	38.3%
sink.....	40%
shelves	
dark green.....	12.9%
shiny tan.....	36.6%
dark brown.....	14.28%
blue table cloth.....	22.7%
white contact paper	
on a table.....	42.3%



Overall Room Averages

footcandles
low....42
ave....72.7-77.7
high....100
dry bulb
low....68°
ave....69.9-74.2°
high....77°
relative humidity
low....28%
ave....33.3%-37.7%
high....58%

Air Velocity

The results were the same as for the first grade. Again, there were no readings at desk height.

Sound Measurements

June 13: this space was not in use, the carpet vacuum was in use in the area.

10:32....73db
10:37....72db
10:42....76db
10:47....48db
1:32....42.5db
1:37....43db
1:42....43.5db
1:47....43.25db

Daily Measurement Averages

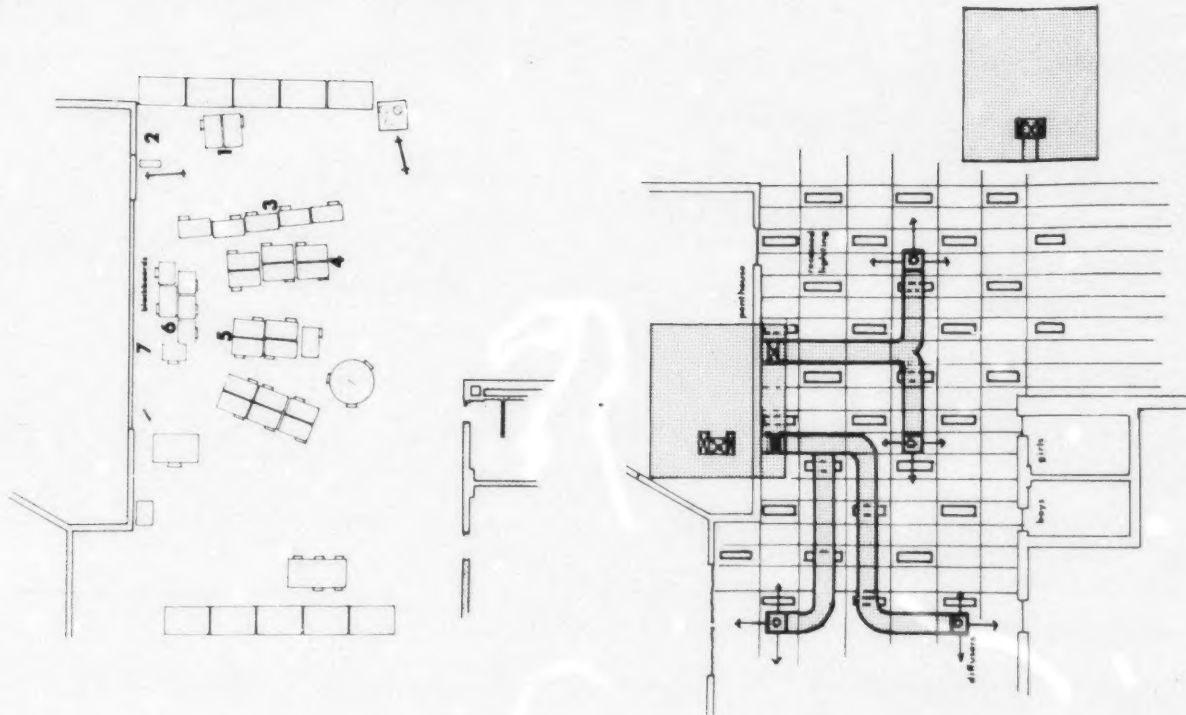
	foot candles		m.	dry bulb		aft.	relative humidity	
	m.	p.e.		m.	p.e.		m.	aft.
1	70	60	70	69.5°	73°	72.8°	29%	30%
a	78.5	77	79	69.8°	73.9°	74.2°	33%	34.5%
h	95	85	90	70.7°	75.2°	75.2°	36.5%	39%
2	45	45	42	Same as Location 1				
a	55	51.2	56.2					
h	70	61	79					
3	69	71	68	69°	73°	71°	28%	30.5%
a	81	86.1	83.3	69.9°	73.8°	73.6°	33.2%	36.9%
h	100	95	95	70.5°	75.5°	77°	38%	42%
4	71	80	70	Same as Location 3				
a	84	90.1	85.5					
h	95	100	95					
5	65	71	60	69°	73.5°	73.5°	28%	30%
a	81.5	81.8	75	70.1°	74.2°	74.3°	33.4%	37.6%
h	100	95	89	71°	76°	76.5°	39%	42.5%
6	70	70	65	68°	73°	72.5°	28%	30%
a	78.3	78.6	68.4	69.9°	73.9°	74.7°	34.2%	35.6%
h	90	92	80	70.5°	76.4°	76.5°	37.5%	41%
7	48	48	48	Same as Location 6				
a	60	62.1	64					
h	70	70	80					
8	73	72	70	69°	73°	73°	31%	30%
a	85.8	82.1	81.8	70.1°	73.9°	74.2°	33.1%	35%
h	95	96	90	71°	76°	76.3°	37.5%	39%

Reflectance Factors

student desk, white	
linoleum top.....	39.4%
teachers desk, same.....	27.2%
table, wood.....	21.4%
ceiling.....	80%
carpet, yellow.....	11.7%
cinderblock wall,	
painted yellow.....	44.4%
	854.4%
	13.63%
wall base, brown.....	
plastic strip, top	
of the wall.....	21.7%
blackboard, brownish.....	24.4%
aluminum frame.....	17.5%
blackboard, back of	
storage units.....	14.2%
blackboard, portable.....	26.9%
bulletin board, white.....	60%
bulletin board, red	
and white drawings.....	33.3%
bulletin board, back of	
storage unit, green...20%	
and tan burlap.....	40.7%
alphabet chart.....	76.9%
shelves, in portable	
storage unit.....	33.3%
storage unit, wood.....	18.7%
student chair	
olive green.....	12.1%
black.....	7.14%
yellow.....	23.3%
red.	11.76%
teacher, chair, orange.....	11.29%

36

51



Shawsville fourth grade

**appendices
and
bibliography** 53

RESOURCE CATAGORIES

fixed markings and readings

chalkborad, bulletin board, wall map, display (train with names, name board)

portable markings and readings

marking (writing and drawing instruments), books, workbooks/ notebooks (math, spelling, language, plan book), experience chart.

materials cyclical

fun games/toys (tinker toys, dolls, firehats, balls, etc.)
maintenance (towel, trash can), container (box, can, bucket, cup, vial, etc.), art materials (scissors, brushes, masking tape, stapeler), learning resources (globe, view-master, yard stick, ruler, number cards, flash cards, blocks, aquarium, seeds, animals, maps, etc.).

materials non-cyclical

art materials (paints, paste, cloth, paper, news paper, etc.)
writing materials, learning resources (dirt, water, etc.)

audio-visual equipment

machine (record player, T.V., radio, cassette, overhead, slide projector, movie projector) picture-sound source (cassette, records, view-master, film, slides, disc) screens, intercom, head-sets.

furniture

horizontal work surface/teacher size, horizontal work surface/student size, seating/teacher, seating/student, portable storage units (filing cabinets, stand, tray, box, cube.)

architectural elements/confines

wall, floor/carpet, ceiling, window/sill, door

"supporting" architectural elements

temperature control (radiator, thermostat, air conditioning),
light control (light fixtures, venetian blinds, light switch),
safety (exit sign, fire extinguisher, medicine cabinet), sink,
electric (extension cord, sockets).

personal

medication (alcohol, gauze, pills, sprays), cosmetic-grooming (brush, comb, hair clips, kleenex) food (candy, ice cream, gum) clothing.

SAMPLE DAILY TAPING SCHEDULE

WEDNESDAY: May 16

Shawsville:	9:00-9:15	Lang. Arts
Belview:	9:05-9:20	Lang. Arts
Shawsville:	12:00-12:15	Social Studies
Belview:	12:35-12:50	Social Studies
Shawsville:	10:30-10:45	Lang. Arts
Belview:	10:30-10:45	Lang. Arts
Shawsville:	1:45-2:00	Math
Belview:	12:00-12:15	Math
Shawsville:	2:20-2:35	Math
Belview:	12:20-12:35	Math

THURSDAY: May 17

Shawsville:	9:15-9:30	Lang. Arts
Belview:	9:20-9:35	Lang. Arts
Shawsville:	10:00-10:15	Reading
Belview:	10:00-10:15	Reading
Shawsville:	11:30-11:45	Social Studies
Belview:	12:50-1:05	Social Studies
Shawsville:	1:15-1:30	SCIS
Belview:	2:1-2:30	SCIS

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NOTE

Gym Schedule:

Shawsville: Mon. and Thurs. = 11:30-12:00
Tues., Wed., and Fri.: 10:45-11:15

Belview: Tues. = 12:45-1:15
Rest of the week = 1:10-1:40

CODE SHEET

ID number

_____	open-1	fixed-2			
_____	tape number	01-99			
_____	stopped frame number	001-999			
_____	first grade-1	fourth-2			
_____	time	8-10-1	10-12-2	12-12:45-3	
_____	day	Monday-1	Tuesday-2	Wednesday-3	Thurs.-4 Fri.-5

1. number involved in the interaction

- 1 1
- 2 2
- 3 3
- 4 4
- 5 5-10
- 6 11 up

2. location

- 1
- 2
- 3
- 4
- 5
- 6
- 7
- 8
- 9
- 10

9. initiator

- 1 student
- 2 teacher (including student teacher)
- 3 administrator
- 4 staff
- 5 adult assistants
- 6 visitors
- 7 fate
- 8 undetermined by tape

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13. classification

- 1 students
- 2 teachers, adult assistants, administrators and/or staff
- 3 students-teachers
- 4 students-adult assistants
- 5 students-administrators
- 6 students- staff
- 7 visitors
- 8 visitors-students
- 9 visitors- teachers, administrators, adult assistants, and/or staff

CODE SHEET

17. students
1 1
2 2
3 3
4 4
5 5-10
6 11 up

21. teachers
1 1
2 2
3 3
4 4
5 5-10
6 11 up

25. administrators
1 1
2 2
3 3
4 4
5 5-10
6 11 up

29. staff
1 1
2 2
3 3
4 4
5 5-10
6 11 up

33. adult assistants
1 1
2 2
3 3
4 4
5 5-10
6 11 up

37. visitors
1 1
2 2
3 3
4 4
5 5-10
6 11 up

41. subject
1 homogeneous
2 heterogeneous
3 combination

45. fixed markings and readings
(chalkboard, bulletin board, wall board, display)

49. portable markings and readings

CODE SHEET

53. materials cyclical
(fun games/toys, learning resources, maintenance, art materials)
57. materials non-cyclical
(art materials, writing materials, learning resources)
61. audio visual equipment
(pic'ture-sound source, screens, intercom, head sets)
65. furniture
(desks, seating, portable storage units)
69. architectural elements/confines
(wall, floor/carpet, ceiling, window/sill, door)
73. supporting architectural elements
(temp. or light control, safety, plumbing, electric)
77. personal
(medication, cosmetic/grooming, food, clothing)
81. terminator
1 student
2 teacher
3 administrator
4 staff
5 adult assistant
6 visitor
7 fate
8 undetermined by tape
83. duration
1 0-10 seconds
2 11-30 seconds
3 31-180 seconds
4 181-300 seconds
5 301 seconds up
85. movement
1 stationary
2 moving
87. observer
1 Katie
2 Paula
3 Mimi
4 Nancy
5 Marcia
6 other
89. 90% or more involved in an identical teacher initiated activity

1 IN THE BOXES ☐ BELOW PRINT YOUR STUDENT ID NUMBER VERTICALLY, STARTING JUST UNDER THE ARROW  THEN BLACKEN THE CORRESPONDING NUMBERED SPACES.

IDENTIFICATION NUMBER									
0	1	2	3	4	5	6	7	8	9
0	1	2	3	4	5	6	7	8	9
0	1	2	3	4	5	6	7	8	9
0	1	2	3	4	5	6	7	8	9
0	1	2	3	4	5	6	7	8	9
0	1	2	3	4	5	6	7	8	9
0	1	2	3	4	5	6	7	8	9
0	1	2	3	4	5	6	7	8	9
0	1	2	3	4	5	6	7	8	9
0	1	2	3	4	5	6	7	8	9

Fixed plan school

Tape number 15

Stop Frame Number 533

First grade

10:00-12:00 noon

Thursday tape

QUESTION NUMBERS GO ACROSS PAGE

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70
71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100
101	102	103	104	105	106	107	108	109	110

2 persons involved in the interaction

Persons were sitting at a table

The student initiated the interaction

Interaction between teacher & student

There was one student involved

There was one teacher involved

There were no administrators involved

There were no staff present

There were no adult assistants involved

There were no visitors involved

Interaction during a heterogeneous class

There were no FMR involved

There was no MC involved

The interaction involved PMR

The interaction involved MNC

There was no AV present

The child was sitting on a desk

There were no AEC involved

No supporting arch. elements involved

There were no personal objects involved

The student terminated the interaction

The interaction lasted from 31-180 sec. 59

The persons involved were stationary

Paula Clem was the observer of the tape

The interaction did not involve 90% of the class or more

definitions relating to the study

open plan school

A school which has an architectural design that provides few fixed constraints on mobility and flexibility of interior objects and user interactions.

open education

An educational philosophy which emphasizes process-oriented, student initiated activities, and which enhances and facilitates individualized learning.

fixed plan school

A school which has an architectural design that includes a number of fixed, similar classrooms with a variety of supporting spaces.

physical resources

Physical objects in the learning space including architectural elements (windows, floors walls...), materials (paper clay, water...), instruments (brushes, pencils...), and furnishings (desks, waste-basket...).

interaction

Discernable communication, contact, attempted contact or pointing involving person/ persons and/or objects.

physical environmental systmes

Qualities of light, sound, temperature, humidity, and air movement in an overall or a specific space.

homogeneous grouping

Activities in which teachers have grouped students who have outwardly displayed a similar level of competence in a specific subject area.

heterogeneous grouping

Activities in which students are not grouped according to any academic criteria.

The mechanical apparatus used in the study consisted of the following:

- 2 Sony Video Rover 11 model AV - 3400/AVC 3400
- 1 RFU-53N RF output module for channel 3 for Video Rover 11
- 2 custom made 70 foot camera cables
- 1 SC Electronics, Inc. 3ER2100 education monitor receiver
- 1 Sony CVM-112 Portable Monitor/T.V. receiver
- 1 Sony 1/2 inch tape videorecorder model AV-3600
EIA - 1 standard
- 1 Videotape 3M 361 1/2 inch - 1/2 hour on 5 1/4 inch reel
- 2 Wide angle lens Sony VCL - 08 8.5 mm f1.5
- 74 Scotch 1/2 inch video tapes
- 2 12 inch by 15 inch wooden shelves
- 2 9"x 15"x 20" cardboard boxes
- 1 General Electric type 213 light meter
- 1 Gossen super pilot C & S light meter
- 2 Weksler psychrometers no. 317
- 2 Princo psychrometers
- 1 General Electric 126 dual range light meter
- 1 Alnor type 1520 Thermometer
- 1 Alnor type 8500 Thermometer
- 1 Bank K type 2205 Sound Level Meter
- 2 35 Format Cameras, Nikkormat & Minolta

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DAILY DATA SHEET

SCHOOL:

GRADE:

DATE:

YOUR NAME:

TAPING SCHEDULE:

TOTAL ABSENTEE:

1ST:

4TH:

LOCATION	BEFORE SCHOOL	am	P.E.	AFTER SCHOOL	pm
1 fc					
wb					
db					
2 fc					
wb					
db					
3 fc					
wb					
db					
4 fc					
wb					
db					
5 fc					
wb					
db					
6 fc					
wb					
db					
7 fc					
wb					
db					
8 fc					
wb					
db					
9 fc					
wb					
db					
10 fc					
wb					
db					

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When measuring data, sketch any change of movement of any furniture

Describe anything that happened out of the ordinary or that seemed to cause a hubbub (i.e., light failure, something spilled ...)

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